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REFRESHER COURSE ON OCCUPATIONAL HEALTH.

FACTORY LEGISLATION-MEDICAL ASPECT.

By Dr. G. G. Davay*

Synopsis

A. Introduction

Factories Act - Social legislation - Protection of control group - Important Section of Society.

Hazards - encountered during employment. Physical, mechanical, chemical and biological.

Scope: Factories Act Section -2 m(i) & m(ii) unit not covered can be notified under Section 85.

B. Legislation

i) Physical - mechanical: Section 21 to 41
- Section 34 - Weight lifting - cause him injury, production rate.
- Section 35 - Protection of eyes from flying particles and exposure to light.
- Section 37 - Explosive or imflammable gases, vapours.
- Section 38 - Protection in case of fire.

ii) Chemical & Toxic Metals: Section 14 - Dust & Fumes.
- Section 36 - Entry in confined spaces, dangerous fumes.
- Section 37 - Dangerous operation; Rule 114 of Maharashtra Factories Rules 1963.
- Schedule II - Electrolytic plating or oxidation of metal articles by use of an electrotype containing chromic acid or other chromium compounds.
- Schedule III - Manufacture and repair of electric accumulators.
- Schedule IV - Glass Manufacturing.
- Schedule V - Grinding and glazing of metals.
- Schedule VI - Manufacture and treatment of lead and certain compounds of lead.
- Schedule VIII - Cleaning or smoothing of articles by a jet of sand, metal shot or grit or other abrasive propelled by a blast of compressed air or steam.
- Schedule IX - Liming and tanning of raw hides and skins and processes incidental thereto.
- Schedule X - Manufacture of chromic acid or manufacture or recovery of the bichromate of sodium or potassium or ammonium.
- Schedule XI - Manufacture of manipulation of nitro or amino compounds.
- Schedule XII - Handling and manipulation of corrosive substances.
- Schedule XIII - Manufacture of Bangles and other articles from cinematograph films and acetone tetrachloro-ethane or other toxic and inflammable solvents.

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* Medical Inspector of Factories, Maharashtra.

Schedule XIV - processes involving manufacture use or evoluti of Carbon-di-sulphide and hydrogen sulphide.

Schedule XV - Manufacture and manipulation of dangerous pes

Schedule XVII - Asbestos.

Schedule XVIII - Manganese

Schedule XIX - Benzene.

Section 89: Notice of certain diseases:

Poisoning or disease.

1. Lead and its compounds
2. Lead tetraethyl
3. Phosphorus poisoning or its sequels
4. Mercury poisoning or its sequels
5. Manganese poisoning or its sequels
6. Arsenic poisoning or its sequels
7. Poisoning by nitrous fumes.
8. Carbondisulphide poisoning
9. Benzene Poisoning including poisoning by any of its homologues their nitro or amino derivative or its sequel
10. Chrome ulceration or its sequel
11. Anthrax
12. Silicosis
13. Poisoning by halogens or halogen derivatives of the hydrocarbo of the aliphatic series.
14. Pathological manifestations due to (a) Radium or other radiot active substances (b) X-Rays.
15. Primary epitheliomatus cancer of the skin
16. Toxic anaemia
17. Toxic ~~xxxxxx~~ Jaundice
18.
19.
20
21
22.

iii) General Health measures:

a) Cleanliness
b) Disposal of wastes and effluents
c) Ventilation and temperature
d) Dust and fumes
e) Artificial humidification.
f) Over-crowding
g) Lighting
h) Drinking water
i) Latrines and Urinals
j) Spitoons.

iv) Welfare measures:

a) Washing facilities
b) Facilities for storing and drying cloths
c) Facilities for sitting
d) First-Aid Appliances *
e) Canteens
f) Shelters, rest room and l
g) Creche
h) Welfare Officers

v) Employment of young persons

C. Enforcement and Penalty

D. Correct Approach.

* Amendment recommended by Evaluation Committee appointed by Government of Maharashtra for inquiry in working of Factories Act and Rules there under:

SOME INFORMATION ON FUNCTIONS OF DIRECTORATE GENERAL FACTORY ADVICE SERVICE & LABOUR INSTITUTES AND ACTIVITIES OF CENTRAL LABOUR INSTITUTE, SION, BOMBAY

DGFASLI :

The Factories Act 1948 and the Indian Dock Labourers Safety Act and Safety, Health and Welfare Scheme are important national legislations for promotion of safety, health and welfare of workers in factories, industries and Ports and Docks. The Factories Act is administered by the State Governments through the Chief Inspectors of Factories and the DGFASLI Organisation co-ordinates the efforts of the State Chief Inspectors of Factories and advises the Central and State Govts. and Factory Inspectorates on matters pertaining to amendments to Factories Act and preparation of Model Rules under various provisions. An Annual Conference of Chief Inspectors of Factories is also organised for discussing matters pertaining to administration of Factories Act. Studies, surveys and research on accident prevention and occupational health protection and imparting training to different categories of personnel are undertaken through the different Sections of the Central and Regional Labour Institutes which form a part of the DGFASLI Organisation.

CENTRAL LABOUR INSTITUTE (CLI) :

The Central Labour Institute, Bombay consists of the following Wings and Divisions :

i) Training Wing	..	Staff Training, Industrial Psychology and Productivity Centre.
ii) Research Wing	..	Industrial Hygiene, Industrial Medicine, & Industrial Physiology.
iii) Safety Wing	..	Industrial Safety, Health and Welfare Centre Ergonomics and Environmental Engineering.

The Staff Training Centre imparts training to Training Officers for promotion of training activities in different organisations and also organises specific skilled development training programmes for Training Officers, Middle Management, Supervisors and Union Representatives.

The Industrial Psychology Division conducts training programmes on different subjects such as Human Interaction Laboratory, Employee Counselling, Transactional Analysis Workshops, Selection and Appraisal Techniques, with the objective of discovering best possible human conditions in occupational work. It also undertakes research studies in industrial and organisational psychology on factors affecting health and efficiency of employees, personnel selection attitude and morale surveys, management styles, accident and absenteeism, etc.

The Productivity Centre provides consultancy services in productivity science for industry and Government Departmen and also conducts training programmes on Materials Management, Administrative Management, Maintenance Management, Job Evaluation, Wage and Salary Administration. It also carries out studies and projects in management problems and in administration, public utility manufacturing and other industrues. To ensure effective implementation of the recommendations, the participation of employees is insisted upon in various studies such as Job Evaluation, Wage and Salary Administration, Production Norms, etc.

The Industrial Hygiene Division undertakes multi-disciplinary research projects and studies in the effects of environmental factors, research into effects of various contaminants on health of workers. It conducts training programmes on chemical hazards in different industries, environmental monitoring techniques and industrial hygiene workshops. It also provides consultancy service and undertakes consultancy studies of specific health hazard problems at the request of the industries.

The Industrial Medicine Division conducts Refresher Courses on Occupational Health for Plant Medical Officers and others to help them in identifying occupational diseases and the preventive measures. It also undertakes multidisciplinary studies and surveys on industrial health problems by undertaki occupational assessment of exposed workers and studies of physical and chemical hazard factors and their health effects. It also advises the management on preventive measures on health protection.

The Industrial Physiology Division undertakes studies and research on evaluation of work capacity of the industrial workers, energy reqgirements of different operations, physiological responses to effects of various stress factors in work environment. It conducts training programmes on Occupational Physiology, Industrial Fatigue and Rest Allowances, Ergonomics etc.

The Safety Wing carries out research regarding prevention of accidents in industrial operations and improvements of working conditions by improvement in plants, equipments, metho and arrangement for accident prevention on securing good worki conditions. It provides training and consultancy service to industry to find solutions to their problems. It also organis training programmes, seminars and conferences on various aspec of Industrial Safety for different levels of management, trade unions and workers.

The Environmental Engineering Section of the Safety Wing undertakes research and consultancy studies for evaluatio of various stress factors and suggest preventive or control measures for health protection.

The Safety Wing periodically organises training courses for Inspectors of Factories from different States.

EVALUATION OF WORK ENVIRONMENT

By

Dr V P Gupta *

INDUSTRIAL WORK ENVIRONMENT

Introduction :

Reference of air sampling and analysis can be applied in ascertaining the quality of air that prevails in two different classes of environments. One class of environment pertains to the industries wherein people are exposed 6-8 hours every day to the pollutants having varying degrees of toxicities. Adverse effects appear due to exposure to concentrations above the permissible limits which could be due to heavy leakages or the accidental failure of the plant or the process. The other class of environment relates to the living environment of the community wherein the quality of ambient air is effected not only from the plant failures or the processes disruption, but due to high emissions from stacks, mobile sources and the people at large. As the air quality in the above two classes of situations can be influenced by several factors, the criteria of sampling, selection of sampling equipment and the methods of analysis may require a thorough knowledge on the subject. For instance, the ambient air quality depends on a large number of factors which may include climatic conditions i.e. temperature, air velocity, wind direction etc. With this in view, my lecture defines and describes the air sampling and analysis in two parts, the first part relating to the industrial work environment and the second part dealing with ambient air quality or the general living environment of the community.

The evaluation of the industrial environment is undertaken broadly to (i) To determine levels of exposure among workmen to various atmospheric contaminants, (ii) To determine the effectiveness of control measures, (iii) To investigate complaints, and (iv) For research purposes.

Preliminary Survey :

The first step in the evaluation of the occupational enviornment is to be familiar with the particulars of the operation in the plants or other establishment to be surveyed. The nature of the hazard i.e. source of contaminant can be judged by raw material used, products and bye-products involved in the process. It is also important to observe the control measures adopted and housekeeping.

Sometimes the visual observation fails to give the correct picture of the industrial environment e.g. the most dusty operation may not necessarily be a hazardous situation. The most hazardous respitable size range dust particles(0.3 to 10 μ) cannot be seen by the naked eyes. The absence of a dust cloud does not, therefore, mean that a dust free atmosphere exists.

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The sense of smell can be applied to detect the presence of many vapours and gases. The odour threshold concentrations of many substances are greater than the generally permissible safe exposure levels. Certain gases and vapo like hydrogen sulphide and carbon tetrachloride can produce olefactory fati especially if these are present in high concentrations.

Sampling of the airborne contaminants :

To have representative samples the following basic question must be answered :

1) Where to sample – Location
2) How long to sample – Duration
3) How many samples – Number
4) When to sample – Covering typical operations.

The above four questions are discussed below :

1) Samples are usually collected in the following areas :

a) At the breathing zone of the worker;
b) In the general Atmosphere of the room; and
c) At an operation itself.

If the purpose is to calculate the average weighted daily exposure th samples are collected at the breathing zone and in the general room air. When the purpose is to define a potential hazard, check compliance with regulations or obtain data for central purposes may be collected in the vic of the operation itself.

2) The factors which determine the duration of sampling or the valum of the air to be sampled are as follows :

a) Sensitivity of the analytical procedure
b) The threshold limit value (T.L.V.) of the particular contamin
c) The expected air concentrations

Another consideration necessary in determining the duration of the sa is that it should usually represent a complete cycle of operations. This useful in determining the operator's weighted exposure. Another technique to sample on a regular schedule e.g. so many minutes every hour. This pro usually requires collection of more number of samples than cyclic sampling procedure and is more or less substituting statistical approach for observ

3) The number of samples to be collected depends on the purpose of sampling. The efficiency of the control measures can be determined by two of samples, one while control method is in the operation and the other whi it is switched off. On the other hand, large number of samples may be necessary to accurately define average daily exposure for a worker engag in the particular operation.

The concentration of the airborne contaminant is also a factor to determine the number of samples needed. A few samples may be sufficient, if the concentration is definitely high but if ~~kk~~ it is near TLV, a minimum of 3 to 5 samples may be necessary to indicate exposure for a certain task or cycle of operation.

Sampling Instruments : The basic requirements of any air sampling instrument are :

a) Source of suction, which may be an electrically or hand operated pump, aspirator or squeeze bulb.

b) Absorbing medium - It should be able to retain efficiently the contaminants to be sampled by absorption, adsorption, chemical reaction or mechanical retention and control.

c) Flow meter to indicate and control the rate of suction of air to calculate the amount of air sampled. The flow meter attached to the instrument must be caliberated with wet or dry gas meter.

Sampling and analysis of Gases and Vapours :

Sampling Method: The two basic methods employed to collect the gaseous contaminants are :

1) Use of a gas collector, such as an evaluated flask. The collector is resealed immediately to prevent loss before the sample is analysed.

2) Passing a known volume of gas or air through an absorbing medium to remove the desired contaminants from the sampled atmosphere. The absorbing medium is chosen according to its efficiency for a particular contaminant.

Gas collector sample may be used to determine the composition of the atmosphere at a specific time. However, the later device i.e. passing air through an absorbing medium should be adopted for collecting continuous samples of a non-uniform atmosphere so that the average composition during a period of time can be estimated.

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to metal oxides of zinc, magnesium, iron, lead and others. Smoke is generated as a result of combustion of organic material (Table I)

Table I

Usual sizes of contaminants

Gases & Vapours	0.0005 - .01	microns
Mists	50.0 - 100	microns
Fogs	1.0 - 50.0	microns
Fumes	.001 - 100	microns
Dusts	0.1 - 1000	microns
Smoke	0.01 - 1	microns

These particulate exhibits similar behaviour when air borne. There are various methods suggested for collecting the particulates including settling, scrubbing, filtration, impingement, Tyndall effect, electrostatic precipitation, thermal precipitation and recently the photometric methods.

Respirable Dust Sampling:

The U.S. Atomic Energy Commission has defined the respirable fraction of dust in terms of sampling efficiency curve which passess through the following points:

100% efficiency at 2 microns
50 % efficiency at 3.5 microns
0 % efficiency at 10 microns

Other criteria for the respirable fraction of dust adopted by Johnnesburg Pneumononiosis Conference (1959) is defined by a sampling efficiency curve which passes through the following points.

100% efficiency at 1 micron
50 % efficiency at 5 micron
0 % efficiency at 7 micron

The concept of the respirable fraction has been applied to the fraction of the dust respired that reaches in the lung and not the fraction of the airborne dust that is literally respirable. The various respirable dust sampling instruments have been developed to evaluate the industrial environment.

To get the desired respirable fraction two types of elutriators used are: (a) Horizontal elutriator, and (b) Cyclone elutriator. These elutriators are connected to the dust sampling instruments to eliminate the non respirable fraction.

Analytical methods used for the determination of the contaminants:

The analytical methods used to determine the concentration of the desired contaminant can be divided into two main classes - chemical and physical methods.

Chemical Methods:

1) Colorimetric: The principle of this method is the development of the colour by a reagent which is indicative of the concentration of the substance to be analysed. Examples of these methods are determination of zinc, lead, mercury etc. by dithizone extraction.

2) Ion exchange: By this technique it is possible to separate elements from one and another. Mercury in urine, fluorine in urine and fluoride sample can be separated for further analysis.

3) Gravimetric Method: This method depends on the formation of a precipitate or a residue which can be weighed. Example is analysis of dust samples for free silica.

4) Volumetric Method: By the use of standard solution for titration. Examples are acid gases which are titrated with a basic reagent.

5) Physical Methods: The physical methods widely used for the determination of the various contaminants are emission spectroscopy, Infrared and ultraviolet spectroscopy, mass spectroscopy, polarogarphy, X-ray diffraction and gas chromatography, etc.

Direct reading instruments for determining concentration of airborne contaminants:

Colorimetric Indicators: The principle of these indicators has been described earlier under colorimetric method. The three types of colorim[etric] indicators are being used:

(1) Glass indicator tubes containing solid chemicals
(2) Chemically treated filter papers
(3) Liquid reagent

Direct Physical Method for Analysis:

Number of direct reading instruments have been developed by vario[us] manufacturing organisations based on the physical method for analysis. The various physical methods applied have already been briefed earlier. The factors taken into consideration for selecting a particular instrument [are] simplicity, specificity, stability and accurancy. Some of the instrumen[ts] are given below:

Some direct reading instruments:

S. No.	Name of instrument	Air pollutant
1.	Noise Band Analyser	Noise
2.	Noise Level Indicator	Noise
3.	Alnor Velometer	Air velocity
4.	Halide meter	Halogenated hydrocarbons
5.	Mercury vapour meter	Mercury vapour
6.	Konimeter	Dust
7.	Cascade Impactor	Dust
8.	Ozone Analyser	Ozone
9.	Digital counters	Dust, SO_2, CO.
10.	Vinyl chloride meter	Vinyl chloride
11.	Explosimeter	Explosive gases
12.	Oxygen meter	Oxygen percent
13.	Thermo-anemometer	Head & air velocity
14.	Vibration meter	Vibrations
15.	Thermal environment kit	Effective temperature

AMBIENT AIR SAMPLING AND ANALYSIS

A. The ob ective of conducting air pollution studi can be severe, exc defining its role ultimately directly or indirec ly to help minimum air pollution. Some of the reasons for such stu es can be as follow

(1) B d odour estimation (2) Soiling of propert (3) irritation of and respiratory tract (4) Impaired visibility (5, Relating pollution sources of emissions (6) Evaluation of control programme (7) Relatin effects to their causes (8) Predicting threats of air pollution to health (9) Prediction of future pollution levels.

B. Planning Air Pollution Survey:

(1) Selection of site and location (2) Size of sampling (3) Rate of sampling (4) Duration of sampling (5) Sampling method.

C. Sampling Methods:

For Aerosols: (1) Sedimentation (2) Filtration (3) Wet and dry impingement methods (4) Electrostatic precipitation (5) Thermal precipitation (6) Centrifugal methods.

For Gases: (1) Absorption methods: Absorption in liquids (fritted glass bubblers, scrubbers, impingers, packed columns, counter curre scrubbers atomizing scrubbers) (2) Absorption (3) Condensation (4) Grab sampling techniques.

For Particulate Matter: (1) Photometric methods based on light sca (2) Photometric methods based on transmission and reflectance (3) Gravimetric method suspended particulate.

D. Metering Devices:

(a) For rate measurement: Pitot tube (2) Orifices (3) Nozzles (4) Rotameters).

(b) For quantity measurement: (1) Dry test gas meter (2) Wet test gas meter (3) Cycloid gas meter.

E. Analytical Methods:

(1) Titrimetric (2) Colorimetric (3) Spectrophotometric (4) Emissio spectrometry (5) Flame photometry (6) Atomic absorption spectrosc (7) Polarography (8) Gas chromatography (9) Column chromatography (10) Neutron activation (11) Fluorimetry.

Some non-automatic methods for common air pollutants

Pollutant	Method	Sensitivity
Formaldehyde	Chromotropic acid method	0.01 ppm or 13/ug/m^3
Fluorides	Microdiffusion	0.2-5.0/ug/m of sample solution.
Chromium salts and acid	Diphenyl carbazide	0.05/ug/f CrO_3/5 ml of solution
Chlorine	O-Tolidine	1 /ug
Hydrogen sulphide	Methylene Blue	0.05/ug/ml of test solution
Nitrogen, dioxide	Saltzman method	0.01-10.0mg/$m^3$9(0.005-5 ppm)
Oxidants	Alkaline KI method	0.042 mg/m^3 (0.02 Oppm)
Sulphate, Particulate	Barium sulphate turbidimetric	1-20 /ug/m^3
Sulphur, dioxide	West Galke	0.015-0.6 mg/m^3
- do -	Barium chloranetate	0.15 mg/m^3 (0.05 ppm) using an air sample to 1 m^3.
- do -	Fuschin formaldehyde	0.024 mg/m^3 (0.008 ppm)

F. Continuous Recording Instruments :

Continuous recorders save time and furnish information on the variations of pollutants level in 24 hours. These equipments are based on colorimentric infrared photometry conductometry, conlometry and chromatography.

Sensitivity of technicon auto-analyser
for typical substances, and reagents used*

Substance	Range	Reproducibility or deviation	Reagent system
Nitrates as NO_3	0.05 mg N/litre	0.003	Zinc reduction nitrite, Griess losvay method.
Nitrites as NO_2	0.02-5.0 mg N/litre	± 1.5%	Sulfanilic aci naphthylamine hydrochloride
Fluorides	0-2.0 ppm	± 1.0%	Alizarin compl zirconium lake
Sulfur dioxide	0-5.0 /ug/ml	± 0.5%	Bleached rosan dye, modified Gaeke method.
Nitrogen dioxide	0.1-5.0/ug/ml	± 0.5%	Azo dye
Phosphates	0-100 ppm	± 1.0%	Molybdovanadi
Chlorides	0.1-100 /ug/ml	1.0%	Mercuric Thioc
Chlorine	0-1.0 ppm	± 1.0%	o-tolidine dihydrochlorid
Cyanides	0-0.1 ppm	± 1.0%	Pyridine, benzidine, br
Silica (water analysis)	0-200 parts per thousand million	± 0.5%	Ammonium molyb 1-amino-2-nap 4-sulfonic ac
Tetraethyllead	0-1.0 /ug/ml pb		Dithizone r

* Zaleiko, N.S. (1963)

HAND INJURIES IN INDUSTRIAL WORKERS

By

Dr. B. B. JOSHI*

Hand injuries are a common feature in industrial workers. It is easy to attribute it to mechanisation but the fact is that the majority of the hand injuries which occur in the industry are not due to the machinery.

Various annual reports of the Chief Inspector of Factory, Maharashtra State put the average accidents of the year about 50,000 per year for the last five years. The percentage of machine accidents to all accidents is about 30% in the general industries while in textile industry it is the highest, i.e. about 50%. These figures show that majority of industrial accidents are not due to machine but are caused by personal factors, i.e. slipping or striking against objects, falls, cuts or handling of the material without machinery. These type of industrial accidents should also form the object of research and planning in the industries.

Magnitude of the problem:

The break up of the figures 50,000 accidents per year shows that hand and wrist is involved in 52% of the accidents, i.e. about 26,000 per year at the rate of about 70 cases per day. Statistics are not available to know about the unreported cases which is suspected to be high due to the claims of involved compensation.

Factors responsible for the accidents:

The factors responsible for the accidents can be broadly divided into two groups -

(a) Factors attributable to workers

(b) Factors attributable to factory conditions.

A. Worker

1. Age
2. Experience
3. General health
4. Attitude to work
5. Level of responsibility
6. Discipline at work site
7. Attentiveness and reflexes of the individual
8. Knowledge of safety devices and specific instructions
9. Resistance to the use of protective equipment.

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To check the accident rate it calls for thorough medical evaluation and assessment of the worker's general, physical and mental healt which need to be carried out not only at the time of entry in the serv but also at periodic intervals. This will help to place the accidents prone individual to safer position at work.

B. Factory conditions:

1. Lack of safety devices
2. Unsatisfactory working hours
3. Atmospheric conditions and general environment at work, i.e, lighting, noise, humidity, heat, etc.
4. Height of the machine in comparison to the height of indivi managing the machine.
5. Attitude of managerial staff to their workers.

Prevention of the accidents needs cooperation and understandin both from the factory owners and workers. It is indeed unfortunate th those hardly exist in our industries and we have the highest accident rate in the world.

Medical Aspect:

Irrespective of the industry, the component of the machinery causing accidents are similar in most industrial plants. These are;

1. Belt and pulley
2. Smooth rollers and spiked rolles
3. Gear wheels and Cog wheels
4. Grinders
5. Cutting Blades
6. Powered press
7. Laundry press
8. Under pressure nozzles ejecting oil for lubrication, air-g spray-guns and molted plastic injections machines.
9. Vibrating tools
10. Hammers.

The nature of injuries caused by these machines could be classified as:

a) Friction injuries,
b) Crushing injuries
c) Avulsions
d) Cuts
e) Burns(heat, chemical and electrical)
f) Piercing missile or punch
g) Injections under pressure
h) Mixed varieties (mangled injuries)

In addition to the acute trauma, the hands in industrial wo may also suffer from occupational diseases due to contacts of materi This may result in various type of contact dermatitis and their aft effects, chronic musculo-skeletal strains, toxic and compression ne etc.

The injuries and disease of the hand in industrial workers need special study regarding prevention of their injuries and results. These will be needed to be studied industry-wise by teams of medical personnels, safety officers, social workers and labour representatives and executives.

Treatment of Acute Hand Injuries

The immediate need in injuries of the hand is to protect it from being infected. The bacterial deposits in early period can be cleared off from the wound to a reasonable extent by methodical mechanical washing of the wound with soap and water. The attention of these injuries is a surgical emergency and needs proper anaesthesia to the patient to do this with thoroughness. This is combined with excision of the of the devitalised tissues as the dead tissue forms a nidus for the bacteria to grow. An early skin cover either by skin closure or by a skin graft is the prime need to protect the wound from getting further infected and heal in shortest possible time. Some of these injuries are accompanied by fractures of the bone. These need stabilisation by fixing the bone internally with wire pins or holding the fracture fragments in alignment by immobilising the part in the plaster or on the splints. The skeletal realignments is very important for the ULTIMATE FUNCTION OF THE HAND. There are 29 bones in the hand with their associated articulations. Even if one bone is out of the alignment, it causes certain loss of function in the whole ray. The hand is an intricate organ. Mobility is the key stone in its performance. The joint rigidity has to be prevented by early institution of movement with the help of splints which keep the part need to be immobilised, secured and permit the other joints to move properly. Elastic bands in the splints supply the necessary force to overcome contracture and also provide artificial muscle action in place of paralysed or damaged muscles. When the tendons are injured they need repair. Primary repair in some of these tendons give good results but in others the repair of the tendon has to wait till full healing of the wound has been obtained.

Tendon grafting and tendon transfer operation may be needed to restore active movement.

Restoration of sensation (sensibility) in damaged hand is a highly specialised part of the hand surgery. Most of the skin grafts are without proper sensation. These may be of nonconsequence if they are not at contatile area. But if working ends have no sensation, the person is greatly handicapped and becomes prone to accidents. It is the presence of sensation which helps one to learn the shape, size, texture and temperature of the objects which is combined with the information and impression from other senses to build in our brain the complete knowledge about the object and the environment in which it is being handled. Restoration of normal perception is carried out by repairing of the severed nerves. The digital nerves of the finger are fine structures and need special care to handle. Precision technique with finest material are needed to secure a good result. This needs working under magnification with loops or operation microscopes.

Shifting of the adjacent normal skin with good sensation is carried out in suitable cases to provide the sensation at the area where they are needed most. At other times island flap from the other fingers with their nerves and blood supply still attached with them are transferred to important

important areas of needy fingers or thumb. This enable the person to use the hand as an organ of perception again.

The hand surgery to-day is a specialised work which needs skill of orthopaedic surgery for restoration of skeleton, the skill of plastic surgery to provide different types of skin covers, the skill of neuro-surgery to restore nerve continuity and the skill of microvascular surgery to restore anastomosis of damaged blood vessels.

The last named skill (microvascular surgery) is the need of time as it has opened new avenues of repair, replantation of digits and portions of the amputated hands and free transplantation of flaps in the place of pedicle graft. It has even permitted free transplantation of the toes for fingers.

When the fine surgery material and instruments become available in our country, these techniques will soon catch the eyes of the younger surgeons and the reconstructive and repairative surgery would develop a new horizon.

The repair of the injured hand needs to be lifted out from the minor surgery department to its proper place of emergency care by skilled staff so that the repair to restore the function in a bread earner of the family could be achieved in the shortest possible time.

SPECIFIC TYPE OF INDUSTRIAL ACCIDENTS

The accidents caused by machinery are a different group by themselves in comparison to the household and other accidents. Various industries inflict their own pattern of tissue damage. As for example saw blade injuries. These cause clean cut wounds extending in depth to complete amputation of the various parts of the hand and fingers. Such injuries are by far clean and tidy and are very suitable for primary repairative surgery.

On the other hand there are power press injuries where the hand is caught in between the two rapidly moving parts, mostly producing the injuries of a compression force. Tissue damage may be extensive in these cases. Nerves blood vessels, muscles, tendons and bones are crushed inside the envelope of the skin without much external wound or laceration. The occurrence of the lacerated wounds are due to bursting of the skin under pressure.

Textile industry contributes to its own pattern of characteristic injuries. The textile machinery has varied complexes so as to produce finished cloth from raw cotton. We have the opening and blow room machinery with its percussions and other feed rollers, horizontal and vertical beaters, lap rollers, belts and pulleys, cog wheels, cate wheel, cone feeders, etc. The injury caused by all these machines is a crushing type and as well as tearing force which make pulp of the involved tissues.

Then there is card room machinery which is used in serial process of separating and combing operation of the cotton fibres. These machines have a common characteristic of a roller drum or canvas belt studded with fine spike. These do the job of making the cotton fluffy before it is fed

to spin yarn and later in combing of the fibres. (The [illegible] type of spikes fixed on these drums will be shown on the slide).

These spiked rollers produce a characteristic [illegible] injury involving the skin, tendons, nerves, vessels, bones and joints.

Another characteristic and extensive damage [illegible] in the textile mills is the injury caused by the callender machines [illegible] the cloth is fed after starch for drying on hot rollers. In these injuries there is not only a contact burn of the hand but also compression injuries of the hand and fingers when these are caught between the hot mobile rollers and cotton-felt padded rollers of these machines. Very often the entire arm is dragged in.

The extent of the injury depends not only on the temperature of the rollers which in these cases is mostly at 110-120°C but the period of contact and pressure exerted by the rollers over the part. When the gap between the rollers is less, the fingers and the hands are crushed, ironed out and discicated, resulting in mumification of the involved part. When the gap is wide enough for the hand to pass in, the maximum burden falls on the wrist forearm and elbow. As the arm is dragged in further, even axilla is involved. The fractures may also be associated in the upper extremities due to pressure effect of these rollers which are characteristically angulatory type.

Apart from these two injuries, the commonest injury is a crushing type between two fast moving rollers or other mobile part of the machine. The distal terminal part of the hand is often chewed up as it takes the burden of the trauma. Multiple laceration are a common feature with varying degree of degloving of the hand. Next to skin to suffer are the bones. The fractures are usually communicated type and of many bones. The muscles and tendons suffer badly both from primary compound injuries and also later on due to adhesion and fibrosis occuring of these structures.

High Pressure Lubrication :

The greese guns are operated by compressed air to eject out the greese by a fine nipple. The compression force reaches to a few thousand lbs. per square inch. Such high pressure lubrication is commonly used in Service Stations of motor vehicles and aircrafts. The emission of fuel oil under pressure in diesel engines duplicate the mechanism of greese gun and provides a similar opportunity for injury. The greese or oil is injected with such a force in a pin point wound of entry that the greese gets into the tissues to a great depth and considerable in amount in few seconds of accidental contact. The worst is that the seriousness of the injury may not be noted instantly but several hours later, due to intense pain produced by it. The wound of the entrance is triffle and only few millimeter in diameter. Paint gun also produces a similar pattern of injury with paint entering the tissue planes in similar manner. Molted plastic injuction machine also produce not only the same type of injury but also burns the surrounding tissues due to its heated contents.

OCCUPATIONAL DISEASES OF THE HAND

Apart from the injuries we see the toxic effect of chemicals introduced in the wounds, such as in flourescent tube industry due to zinc berrylium silicate as a part of the contamination [illegible] skin break. These produce chronic ulcers and granulateous wound [illegible] by wide excision and skin grafting. Similar comparable injuries are seen in lead battery industries and in pencil industries [illegible] dyes mixed with graphite.

Contact dermatitis is another feature of the industries contributing to the disability of the hand.

Diseases like anthrax in workers coming in contact with [illegible] and hides has been already accepted as industrial disease under the Workmen' Compensation Act.

In addition to the acute trauma inflicted on the hand, the disability may occur in the hands as a result of the chronic strains of the various musculo-skeletal elements which are the effects of subminimal trauma repeated days after days and years after [illegible]. The commonest are

1. Occupational bursitis callosities and ganglion at the wrist
2. Trigger fingers and thumb,
3. Driller's wrist when bone cyst forms due to [illegible] of the bone in the carpal bone due to constant vibratory trauma
4. Games-keeper's thumb
5. Implantation dermoids
6. Pillionidal sinuses in barbers hand
7. Welders burns
8. Precancerous condition produced by constant contact with coal tar dyes. Contact with X-rays may produce burns and chronic ulcers.
9. Chronic lead and arsenic poisoning may produce palsies of the nerves.

SUMMARY

The hand in the industrial workers need special studies regarding the prevention of injuries and their managements industry-wise. These injuries are complex in nature and side effects are too many both to the employer and the employee. It is in the fitness of the things that the industrial worker who with the very abilities of his hand increases the production and exposes himself towards the cruelty of the machine, needs a better deal in his looking after.

ckc.

27th REFRESHER COURSE ON OCCUPATIONAL HEALTH

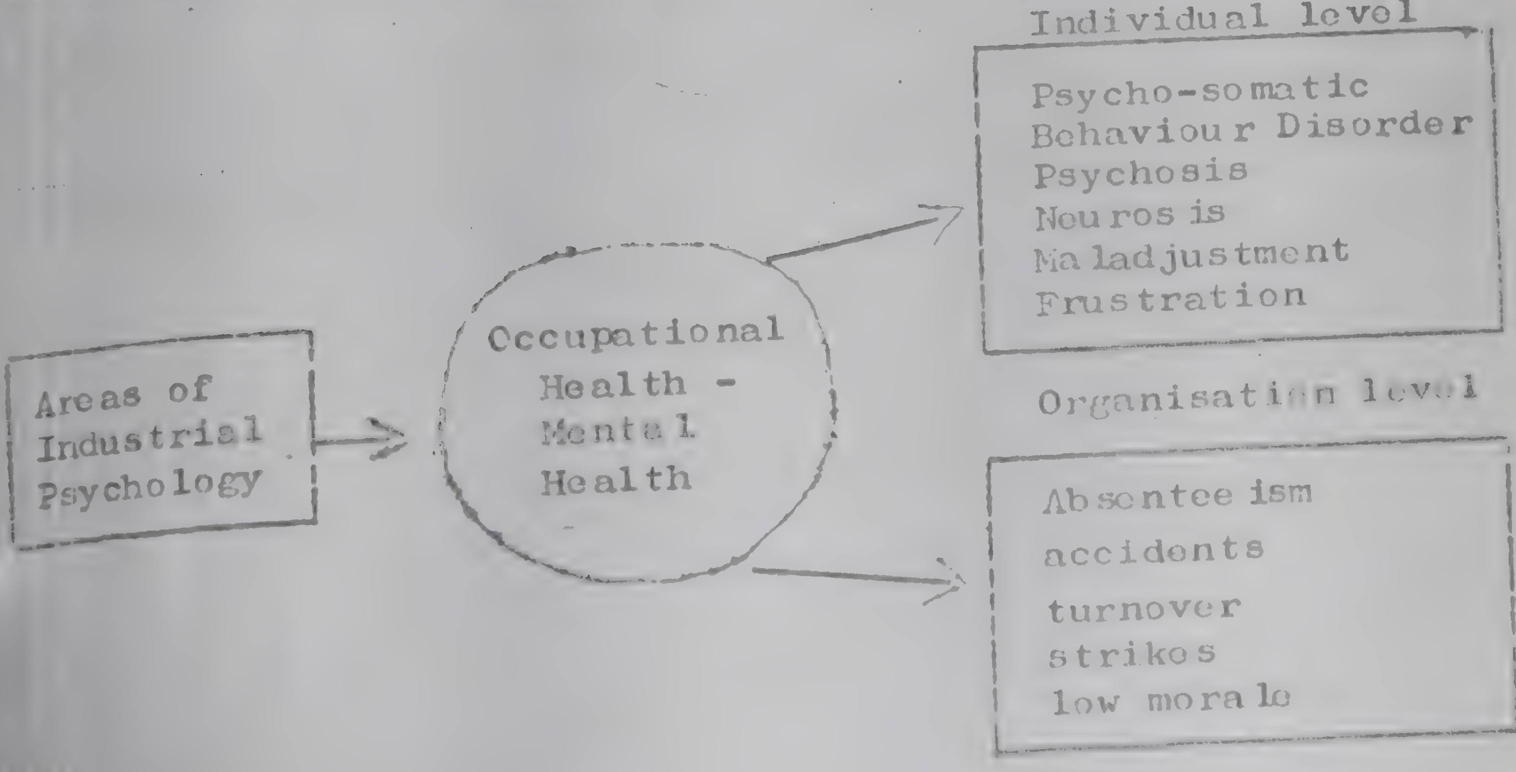
INDUSTRIAL PSYCHOLOGY

Dr. O.N. Ganguly

Traditionally, Industrial Psychology is concerned with the following areas in order to improve organisational effectiveness and individual satisfaction and well-being.

1. Selecting right man for the right job
2. Motivating through studies on attitude job satisfaction
3. Finding out causes of lost t me, viz.accidents ab enteeism
4. Effect of working conditions stress, fatigue, toxic etc.
5. Fitting the job to the Man - Ergonomics
6. Organisational Development through training, data-feedback team development interventions

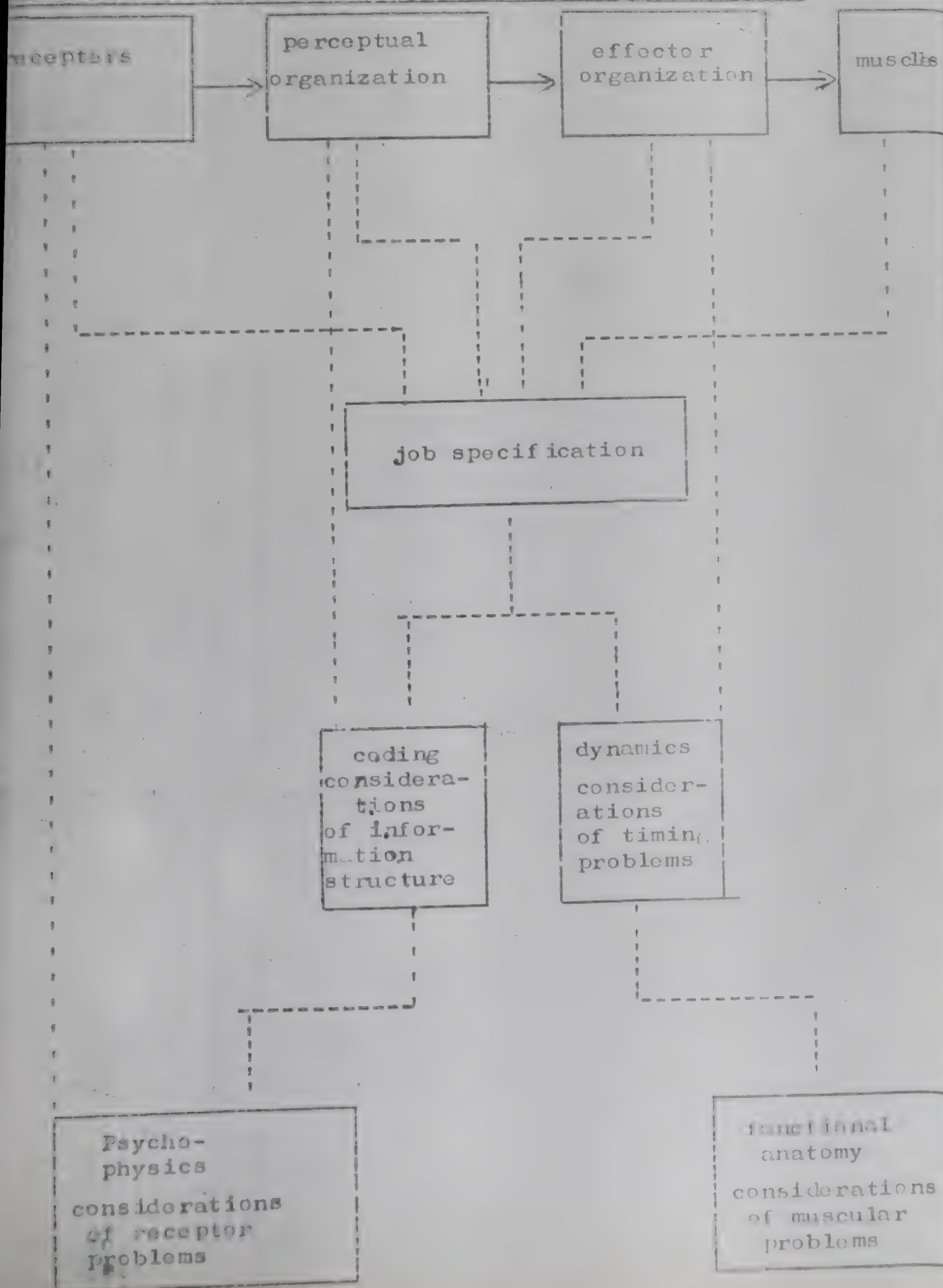
The areas of Industrial Psychology from the perspective of occupational health point can be viewed as follows:



Four major problem areas of Medical Officers in Industry where Industrial Psychology plays a vital role.

1. Selection. Various psychological tests can be used during medical examination at the recruitment stage and periodic medical examination. The model given below will help to select the right type of tests.

HUMAN OPERATOR AS AN INFORMATION PROCESSING DEVICE



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2. Effect of Working Conditions, toxic substances etc.

Effect of CS_2, lead, carbon monoxide and hundred of other chemicals have depressing effect on psychic performance. Vigilance speed, memory, eye-hand coordination insudiously get affected. It is possible to correlate test results with subjective medical history at the early stage and objective symptoms revealed by medical examinations at the latter stage.

3. Absenteeism: Counselling: Counselling is a process of assisting problem afflicted individual to take his own decision. It may be noted that counselling is not advising. It requires understanding, empathy and skill in listening and communicating.

4. Mental Health. Review of research shows that the problems of mental health in industry have been attacked from the following four angles.

a) Psychiatric/clinical examinations of exposed cases like paranoid, schzoid etc. Such cases do not pose serious day to day problems of Medical practitioner in industry. They are referred to Psychiatrist.

b) Job Satisfaction

Measures of Job Satisfaction is an indirect index of mental health. Job satisfaction studies are carried out by Interview/ Questionnaire methods to assess the attitudes of employees towards various facets of the job. Job satisfaction is a function of need fulfilment, need importance and need expectation.

c) Job Stress

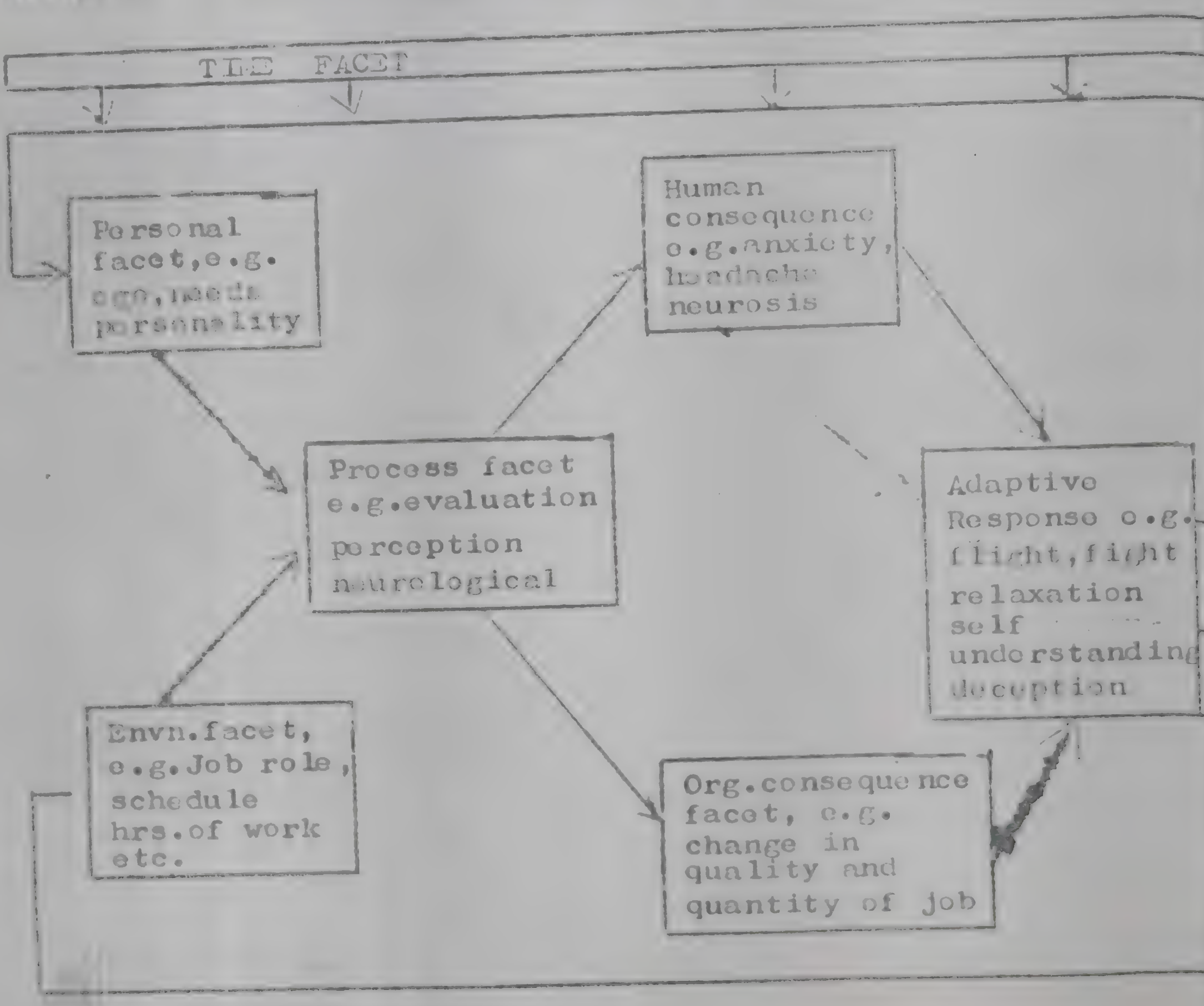
Stress refers to any characteristics of the Job environment which poses a threat to the individual. Two types of threat may threaten the person: either "demands" which he may not be able to meet (the extent to which the person's skill, ability match the demand or requirement of the job) or insufficient "supply" to meet his needs (extent to which the person's needs are supplied in the job environment). Job stress, then, is conceptualised as a misfit

of either of these relationship between employee and job ...
when misfit of either kind threatens and individual well-being,
strain will occur. Thus strain is defined as any deviation
from normal responses in the person. Psychological strain is
dissatisfaction, anxiety; physiological strain is high blood
pressure, elevated serum cholesterol and behavioural symptom
of stress is smoking, dispensary visit.

Job stress is also defined as a condition at work interact
with worker characteristics to disrupt psychological or physiol
gical homeostasis. The causal situational conditions are job
stressors and the disrupted homeostasis is job related strain.

There is also a physiological concept of stress. In this sense, stress is a reaction to a stressor. It is a non-specific bodily response to any demand. Stress is not, therefore, necessarily a response to excessive demands.

A review of the empirical literature related to job stress and employee health arranged according to general model is given below.



d) Besidés measure of JS and Job Stress mental health include following measures of workers' psychological sense of well-being, viz.

- Job tension (see Questionnaire Appendix)
- Somatic complaints & Psychic demands
- Depression
- Zest
- Performance debilitation
- alination

Over the last 15 years, it has been observed that job-satisfaction and overall mental health survey data feed back along with various short-term training intervention strategies enhance organisational effectiveness.

COURSE FOR ESIC MEDICAL REFEREES, PLANT MEDICAL OFFICERS
AND OTHERS

INDUSTRIAL MEDICINE DIVISION
CENTRAL LABOUR INSTITUTE
BOMBAY.

HEALTH OF THE EXECUTIVE

By
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S y n o p s i s :

Health of the executives has received considerable attention in recent years. And that too for good reasons. Business cannot afford to be run by executives who are not fit. On their decisions depends not only the prosperity or loss of the business but also the maintenance of good human relations and the fate of the numerous employees. A sudden death of the executive means, sudden dislocation of the smooth running of a business and leaves a void that cannot be easily filled specially in a developing country. Business, therefore, is genuinely interested to see that the men who guide its destinies are kept hundred percent fit.

One other factor that has helped the subject to attract public attention is the panic created by press and incomplete survey reports on executive health. These reports have created such a frightening picture that executives themselves have started believing that they must pay the penalty for being an executive in the form of ill-health and sudden death. People have started calling a group of ailments as "executives". The typical executive, according to these reports, is under severe strain subjected to constant heavy pressure of modern business, is tired, tense and over-worked. As a result, he developes ulcer, sleeplessness, high blood pressure and meets with an early and sudden death.

Fortunately, over the years, this picture of executive health has undergone changes as a result of scientific investigation. Studies have been undertaken by Medical Associations, Life Insurance Companies and industrial medical officers in different countries, mainly in the United States and the United Kingdom. A fund of information has accumulated as a result of extensive group health studies, researches and periodic health check up reports of executives. These studies point out that the executive is no worse off than any other occupational group, he does not die younger - in fact he has a higher life expectancy. The worst that can be said about his health is that he is subjected 'to the same hazards to health as doctors, lawyers, civil servants' and all those who belong to the higher income group (or social class I)','To consider their health problems in any other way would be to obscure realities and separate them in an arbitrary and invalid fashion from their fellows who do not work in industry and commerce' (O'Dwyer).

In a study undertaken by Lee and Schneider it was found that there was significantly less arteriosclerotic diseases among executives than expected and no relationship between level of

responsibility and incidence of either hypertension or microbial
infection was seen. Possibly executives are healthier than other
workers to start with or have means of releasing their tension
take proper care of themselves than other workers'.

TABLE - 1

Arterios clerosis and hypertension among executives and non-executives

Disease	Top Exec.	Exec.	Minor ex.	All Exec.
Hypertension	11%	9%	13%	12%
Ariteriosclerosis	12%	8%	7%	8%
Myocardial infarction	4%	4%	3%	4%

1,171 male executives and 1,203 non-executives of whom 56
were females. R.E. Lee and R.F. Schneider Journal of American
Medical Association page 1147 July 19th, 1958.

This information may deprive a few executives of the pleasure
of considering themselves 'martyrs' (of affluence), but it is very
heartening to know that there is nothing about this occupation that
might bring about an early death or infirmity; in fact in many
respects the executives are much better placed. Our experience in
this country is similar to the findings of the Western countries
e find not only the mortality rate amongst our executives to be
ess than the other groups in the factory but that the executive
uffer from less number of illnesses as well.

This does not mean that nothing needs to be done about the
ealth of the executive. In fact there is much that can be done
njoy better health, to increase fitness and to avoid some of the
lments that affect them. A positive approach to health and sober
ving habits may avert a large number of ailments that are common
them. There are many illnesses and deformities that come un-
trusively and make their presence known only when they are far
vanced. Take for example diabetes. If this disease is detected
rly and simple steps taken, like controlling the diet, then one can
sily prevent its further progress, keep it under control and lead
perfectly normal life. There is a host of other diseases of this
egory.

To detect them early, a thorough check up or health super-
ion must be undertaken periodically. There is nothing unusual in
s advice. We insist that the machines used in factory or our
ines should be periodically checked and attended to for proper
ntenance. We know that such check ups would avert a major dis-
r. If this is necessary for an engine, should it not be more
ssary for a far more complex system of engines which is human
? This is not only necessary, but is essential if we want to
in healthy and hundred per cent fit. Table II will show the
e of this examination.

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TABLE - II

Incidence of diseases or defects of the same group of employees detected during periodic health surveys.

Age group	Detected during first health survey	Detected during next health survey after two years
19 to 28 years	9 per cent	3 per cent
29 to 38 years	27 " "	9 " "
39 to 48 years	36 " "	11 " "
49 and above	57 " "	20 " "

When we first examined a group of people, we found a large number of them having some minor defects or diseases in a dormant form in spite of the fact that all of them had undergone a rigorous pre-employment examination at the time they were employed. However, when they were told about these minor defects, most of them took steps to correct these themselves. The result of examination two years after the first one showed the number of cases where corrective steps have been taken by the employees themselves.

It is immaterial who arranges this check up. If the company we work for does not provide such facilities (most progressive concerns do) then it shouldbe arranged with your own doctors. The important thing to remember is that it should be done periodically by a competent man with a view to detect diseases and deformities in an early stage. It has been argued that to be effective, this examination should not only include a through physical examination but also extensive laboratory tests should be undertaken. Opinions differ regarding how extensive these tests should be. The general consensus of opinion today, however, is that a thorough physical check up with some laboratory tests like examination of urine, blood, stool, x-ray of chest are generally sufficient for a young healthy executive - further investigations should be undertaken only when these are indicated during the physical check up. Our experience confirms this view but we think some special tests should be included as age advances. With advancing age, certain special disorders are more likely to make their appearance. An ECG examination after 45 years of age, a thorough search for early appearance of cancer in certain organs or bone changes in joints should be undertaken as age advances.

The need for increasing the frequency of these check ups also increases with advancing age. We think that those above 40 years of age shouldhave a check up every year, while those below this age group may have it every 2 or 3 years. This of course is a 'rule of thumb' and one should be guided by one's own doctor. The time for medical check up is also the time when inoculations and vaccinations should be taken for protection against epidemics like small-pox, cholera, typhoids etc. that unfortunately still visit our country.

It is not easy to detect diseases particularly those that have functional or emotional origin. One must therefore help the doctor by confiding in him and hiding nothing. Full coperation is

necessary. It is not sufficient, to restrict discussions to physical ailments alone. A frank discussion about one's prob ing home, office and friends that are affecting emotionally, also necessary. Only then the doctor can give useful health s lling which need not be restricted to physical health alon guidance and first aid to emotional health are equally vital.

A significant point to remember about periodical medical examination, is that it can only detect what is present but cannot predict about future ailments. A normal healthy heart today does not mean that it cannot be diseased in future - hence the need for frequent check-ups. A report that there is nothing wrong with your health should give reassurance but not a sense of false security for the future.

In the company I work for we carry out a health survey the employees (at all levels) periodically in our organisati (6500 employees out of which 375 are executives). The health data collected during the examinations for 8 years, will be short published in detail in another paper, The following observati relevant to this subject, are interesting. ('Non-executives' mean office staff, factory workers and salesmen).

1) Incidence of certain diseases like tuberculosis, anaemia deficiency diseases, is significantly lower (almost non existant) amongst the executive group.
2) The incidence of common ailments like cold, diarrhoe dysentry etc. are comparable in both groups but the cidence of lower respiratory tract infections like bronchitis, pneumonia are less amongst the executive group.
3) There is no significant difference in the incidence peptic ulcer, coronary heart disease, high blood pre in the two groups, but the incidence and mortality due to heart diseases(of all varieties) is lower in the executive group.
4) There is a definite higher incidence of diabetes, obesity, haemorrohids, 'joint ailments', low back-ache amongst the executives.
5) There is an increased incidence of minor functional diseases like head-aches and labile hypertension.
6) The total volume of sickness (all types) causing absence is less amongst the executive group than among the non executives, and the number of work days lost due to sickness is about one-third per head in the executiv group as amongst the non-executive group. This may b at least partially due to the fact that executives tend to have a greater sense of responsibility and not remain absent for minor ailments.

We then see that in our experience the executive group has a higher incidence of diabetes, high blood pressure, joint trouble, piles and obesity. Diseases like tuberculosis, anae etc. are almost non-existant. Incidence of heart disease is comparable between the two groups. In fact the mortality due to heart disease is higher amongst non-executives. Some of these ailments are completely preventable if we only acquire the right and sobre habits of living. Take for example, over weight. Except in a few rare instances, over weight is due to over eating and doing less physical exercise. Yet, over weight has been

to be associated with lowered life expectancy (a person of 40 years who is 25 lbs. overweight has a 25 per cent lowered life expectancy). Incidence of diabetes, heart diseases, high blood pressure, joint diseases is most higher among the over weights. In fact this is a major problem today of the affluent class (the executives belong to this class) and can be prevented by being careful in one's eating habits. Similarly, smoking. Itis known for certain that smoking affects heart and increases the chances of cancer of lungs. It is not difficult to give this habit up. We propose to discuss a few of these habits briefly (space does not permit detailed discussion).

1) Over eating :- There may be some truth in the saying that over eating is an 'occupational hazard' of the executives. Frequent official lunches, banquets and sumptuous dinners (after cocktails) for entertainments expose one to overeating of a particularly rich type of food, highly spiced and over cooked with lavish amount of fat. In between snacks, sweetened drinks and cocktails add upto the number of calories and naturally the waistline imperceptibly goes on increasing. Check your weight with the chart (Table III) and take off the excess weight - in a slow but steady manner (a reduction of 4 to 5 lbs. per month is satisfactory) by making a habit of eating the desirable amount of food. There is no need to go on a 'strict diet' - the effect of this may be dramatic but rarely permanent. The best way to reduce is to eat less, avoid excess fat like butter, ghee and oil, fired foods, excess carbohydrates like rice, potatoes, green peas, sweets and avoid snacks in between meals. Add plenty of salads, green leafy vegetables and fruits in your diet.

TABLE - III

Desirable weights for men, aged 25 and over according to height and frame

Height (in inches)		WEIGHT IN POUNDS(in indoor clothing)		
Feet	Inches	Small frame	Medium size	Large frame
5	2	112-120	118-129	126-141
	3	115-123	121-133	129-144
	4	118-126	124-136	132-148
	5	121-129	127-139	135-152
	6	124-133	130-143	138-156
	7	128-137	134-147	142-161
	8	132-141	138-152	147-166
	9	136-145	142-156	151-170
	10	140-150	146-160	155-174
	11	144-154	150-165	159-179
6	0	148-158	154-170	164-184
	1	152-162	158-175	168-189
	2	156-167	162-180	173-194
	3	160-171	167-185	178-199
	4	164-175	72-190	182-204

..6

2) Smoking : There is no doubt that smoking is bad for health. Cancer of lungs is 42 times more often among those who smoke 40 cigarettes a day than among non-smokers. The higher number of cigarettes smoked, the higher the chances of lung cancer. It has also been seen that in people above 40 years, the inc of coronary heart disease is three times more prevalent among kers than among non-smokers. Is the pleasure of smoking worth risk?

3) Drinking : Although this is not a major problem in our country, do not start this habit if you are a teetotaller. Many young executives, initiated at the office cocktail parties, difficult to do without it. Medically, a peg a day is not ha to health but it should never be more than 2 pegs under any stances. In certain individuals a drink may help to relax; b since it provides extra calories (about 100 cal. for one oz.) make one more hungry - these, who have to reduce, should neve touch it.

4) Exercise : Some amount of physical exercise daily helps a lot. This need not be a strenuous gymnastic : walking, swim playing golf or tennis, whatever you like, will do. The human is made for movement and functions normally when the parts are moved regularly. Sedantary habits, encorcing disuse of the muscles and joints, lead to a number of ailments like joint p low back-aches, etc. Exercise helps to improve circulation of parts, tone them up and prevent or at least delay the onset o changes that come with advancing age. Physical exercise also to burn up the excess calories and keep the body fit and trim This is also the best way of relaxing.

It has been shown in repeafed studies that those who do regular physical exercise suffer much less from heart attacks those who are sedentary in habit. Opinions differ regarding the value of different measures recommended to avoid heart diseas but experts all over the world are unanimous on one advice - physical exercise tones up heart muscle and thus defer or prevents heart attacks. I would like to stress once again that exerci should be regular but never carried to the extreme, leading t fatigue and exhaustion. One must be moderate, specially with advancing age. Medically prolonged and strenuous exercise lik walking is safer and more beneficial than short bursts of in activities like playing squash or badminton. Walking is the b exercise for any age, specially so for the elderly. It is a good idea to use the staircase rather than the lift so long as you not get uncomfortably breathless.

5) Sleeping : Approximately 7 to 8 hours of sleep is n cessary for a normal individual. With advancing age this requ ment actually lessens so that by 60 years about 6 hours are Insufficient sleep produces a stato of constant tiredness and fatigue apart from increasing tension. Exercise and relaxatio the best means of getting sleep - not sleeping tablets. Too m cups of tea or coffee affect sleep.

6) Relaxation : The business executive is proverbially a tense person - a victim of stress and responsibility. There no doubt that excessive stress is harmful but human beings in every cadre of life have to face stress. Normally, in small

it helps to keep alert and lively. Only when it goes on accumulating ailments start. Peptic ulcer, coronary thrombosis, high blood pressure, excessive thyroid activity, certain skin disorders and asthma are at least partially stress disorders. It is therefore very necessary that every one - the business executives especially - must know how to relax. Hobby, sports, exercise, spending some time wi h children in the evening, all these are excellent means of re axation

One way of avoiding unnecessary amount of stress is to develop the right attitude to life. Ambition is a des quality - but over-ambitious individuals will bring forth their own ruin - particularly if he is of the over aggressive and over enthusiastic type (drive is an excellent quality for the executive). The young executive who dissipates his health resources by over enthusiasm for reaching the top of the ladder in the shortest possible time is 'in a sense, taking money out of one bank, his health, only to put it in another, his career'.

In his later years he may pay the penalty by losening his resources from both banks. Examples of such over aggressive types of executives abound in industries today who get frustrated if not promoted quickly and depressed when over promoted. He has to develop the proper perspective, the right values, the right attitude towards lîfe.

Let us, therefore, "cease thinking of senior managerial task in industry, as being exposed to any special occupational hazard and avoid the hypochondria that comes of thinking in that strain" (O'Dwyer) and accept a sane attitude towards like and work.

In general, I cannot advise anything better but to quote what the famous authority on heart and circulation, Sir Thomas Lewis said :

> "Very prudent people live quietly and moderately. They have their simple routine of work and pastime. They are temperate in their eating. They are strictly temperate in their drinking. They avoid all forms of excesses. They use tobacco ittle, if at all. They welcome the freshness of abundant open air and open spaces, delighting in the feelings of exhilaration that accompany active exercise'.

Ref. 1) Johnson, Harry J. : Keeping fit in your executive job; Published by American Management Association.

2) Davies, Sir Daniel, Stress and Responsibility pp. : 11-25; The Health of Business Executives; Transactions 1959 by the Chest and Heart Association of London.

3) O'Dwyer, J.J. Over work and Fatigue : Age 26-31; The Health of Business executives; transactions 1959 by the Chest and Heart Association of London.

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AVB:

NOTES FOR ESIC MEDICAL REFEREES, PLANT MEDICAL OFFICERS AND OTHERS

INDUSTRIAL MEDICINE DIVISION
CENTRAL LABOUR INSTITUTE
BOMBAY.

WORKMEN'S COMPENSATION ACT

By
Dr. R. H. Dastur*

Synopsis

1) Historial survey :

Hazards of work : Employer had to be sued for negligence. Machine age and increase in accidents. Evolution of Workmen's Compensation Act in civilized countries. India passed the Workmen's Compensation Act in 1923.

2) Accidents :- Definition -

Personal injury arising out of and during the course of employment. Accident is unlooked for mishap or untoward event. Personal injury refers to an injury to his person and not belonging Arising out of employment - is incidental to work or results from employment. In the course of employment - refers to the time during which he is employed.

3) Disability : Temporary / Permanent — Partial or Total

Temporary disablement is that disablement which temporarily reduces the earning capacity of an individual.

Permanent disability is permanent damage or loss of function in a part which is left as a result of an accident after all possible means of treatment are given and sufficient time has elapsed for the disability to be stabilised.

Schedule and non-schedule injuries :- Estimation of disability in non-schedule injuries depends on loss of earning capacity which is proportional to loss of function.

Components of Function : 1) Motion (2) Strength (3) Co-ordination

4) Upper Extremity :

Function is prehension or grasping of objects. The two radicles of upper extremity are : 1) Arm Radicle (2) Hand Radicle.

Arm Radicle: Shoulder plus Elbow plus Wrist = 90% :

Shoulder Joint = $\frac{90}{3}$ = 30% as each joint is given an equal value.

The loss of each factor in the shoulder is estimated:

e.g.	1) Motion	50%
	2) Strength	33%
	3) Coordination	30%

The functional loss of arm radicle is equal to maximum loss of any

Total disability of arm radicle is equal to disabilities of shoulder plus Elbow plus Wrist:

Hand radicle : The three components are :

a) Thumb finger apposition = 40% of value of hand
b) Finger palm grip = 30% ,, ,, ,,
c) Inter digital grip = 30% ,, ,, ,,

Loss of hand or of thumb and four fingers of one hand = 60%

Thumb finger apposition	= 40% of 60%	= 24%
Inter digital grip	= 30% of 60%	= 18%
Finger palm grip	= 30% of 60%	= 18%
Total	100%	60%

Disability of entire extremity is maximum disability of the two radicles.

Disability of arm radicle	20%
Disability of hand radicle	15%
Disability of entire extremity	20%

5) Lower Extremity: Function is weight bearing. Hence stability is the key note.
The three components of function are: 1) Motion 2) Strength 3) Weight bearing.
The three joints are: Hip plus Knee plus Ankle = 90%
Each joint is equal to 30%. The Disability is calculated in the same way as upper extremity.

6) Spine: Consists of 7 Cervical, 12 Dorsal, 5 lumber, 5 Sacral and 4 coccygeal vertebrae.

The most important lesion are compression fractures of the body of the vertebrae.

Lumber Region	: 50% to 100%
Dorsal Region	: 25% to 50%
Cervical Region	: 20% to 30%

Fracture of spinous or trasverse process 5 to 10%.

7) Thorax : Fracture of 1 rib usually no disability.
3 - 4 ribs = 5 - 10% when there are after effects.
Sternum = 5 - 10%

8) Head injuries Disability evaluation depends upon after effects.

a) General symptoms : Headache & giddiness
b) Mental symptoms : inability to concentrate
c) Focal symptoms : " hemiplegia, etc.

Headache & giddiness = 10 - 20%
Focal symptoms - depends upon part evalued.

9) Eye : Loss of vision of one eye is 30%
Loss of vision of both eyes is 100%
(Disability is estimated without glasses).

6/18 : 30% loss of vision = 9% permanent partial disability
6/[illegible] : 40% loss of vision =12% permanent partial disability

HEALTH HAZARDS IN FOUNDRY - AND CONTROL MEASURES

By
Dr. Surendra Nath
Assistant Director(Medical).

Synopsis

The process of foundry operations are as follows:

1. Preparation of mouldling materials, i.e. design and pattern making for the mould and care, and the preparation of sand.

2. Making of the moulds and cores.

3. Melting of the metal in the furnace and pouring or casting of the molten metal into the mould.

4. Removal of castings from the moulds and cores, i.e. stripping, knock out and decoring operations. Sand is reclaimed for further use.

5. The casting is then cleaned and finished by fettling which may require shotblasting, grinding and chopping.

The basic principle of foundry technology have changed very little over the years, though there have been considerable development and modernisation. Some of the process have been mechanised and automated. In the making of the mould and core, new materials have been used, for example plastics are sometimes used in place of wood in making mould patterns. New matels and alloys are also increasingly used for making castings.

Materials Used:

1. Metals - Originallay iron, steel, brass and bronze were mainly used. Due to increased demand for light weight and stronger castings, various alloys have been developed using allumirium, chromium, nikel, titanium, magnesium, beryllium and cadmium. Sometimes zinc, lead and copper are also used.

2. Moulds - Moulds are usually made from silica sand bound with clay. Organic binders are also used. For example, dextrin, starch, molasses, oil and synthetic resins. Organic solvents may be used in moulds dressings and coatings. Cores are made from silica sand. As a binding material, natural sugars and oils were previously used. Now-a-days, synthetic resins are frequently used. Moulds are also made of ceramics, plaster of paris or even metals.

Enumeration of Hazards

(A) Physical and Mechanical hazards: - Burns(from molten metal) injuries (cuts and bruises, severe trauma and fractures from accidents), foreign bodies (eyes), heat and glare (from furnace and molten metal), ultra-violet radiation (from welding), and noise are the main hazards.

(B) Dust, Gases and Chemical hazards: - Dust and fumes of metals or iron, zinc, lead, brass and other metals already named can cause respiratory or systemic diseases, depending on the human toxicity. Toxic gases may be present either in the fuel gas of the furnace, such as carbon-monoxide, sulphur dioxide, and phosphorus pentoxide may be generated from baking of cores and the pouring of molten metal into the moulds, e.g. carbon-monoxide gas.

[illegible]

1) Metal fume fever

Nair.

2) CO Poisoning

3) Pulmonary [illegible]

4) [illegible]

NUTRITION AND WORK PERFORMANCE

By
Dr. S. S. Ramaswamy *

INTRODUCTION:

Industrial work output as well as the sensation of comfort of the workers can both be maintained high only if the fatigue during the shift is kept low. Apart from the superimposed influencing factors such as thermal level, illumination, ventilation, noise level etc. the primary contributory factor for fatigue will be the relative workload. The energy requirement or demand of any physical task on the shopfloor such as moving heavy loads, is almost fixed. Naturally, if a small statured man is to complete this fixed task the relative workload becomes high and for a big sized man, the relative load will be low. More precisely, the relative workload is much lower in respect of a worker with higher oxygen uptake or energy expenditure capacity than with another with lower capacity. Since oxygen uptake or energy expenditure capacity is determined by the overall size of man and his musculature, all those factors which influence these latter two, also influence the capacity for energy expenditure. For maintaining the body stature and musculature a high calorie intake with high protein content is necessary. It is thus the caloric and protein content of food apart from other factors will influence the industrial work output.

LOW BODY WEIGHT OF INDIAN WORKERS - IMPACT ON PRODUCTION

The Indian workers are in a state of under nutrition, with their body weight being quite low (Table 1). The experience in West Germany during and immediately after the second World War showed that there was a parallel lowering in industrial output, when there was body weight loss (Fig. 1). Controlled experiments on semi-starvation carried out in USA (Fig. 2) confirmed that this reduction in output could not be due to psychological factors, but due to actual reduction in individual capacity.

NUTRIENT REQUIREMENT FOR MAINTAINING INDUSTRIAL WORK OUTPUT:

1) Calorie content of food should be adequate:
   a) to meet the basal metabolism (about 50 Kcal/hr.) plus
   b) additional calories to meet the activities outside shift hours ; (about 70 Kcal/hr.) plus
   c) energy needed during 8 hours of shift; plus
   d) 10% for faecal wastage.

The energy expenditure in some shift work will be as high as 1600 Kcal. in 8 hours (Table 2)

2) Protein:

Maintenance protein requirement of an adult has been put at 1 gm. per kilogram of body weight per day. This much will be already available in our normal diet even if the diet is not adequate in calories (Table 3)

---

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There is a misnomer that a fraction of the protein intake should be of animal origin. This is unnecessary. If it is vegetable protein from mixed pulses, it will be a protein of high biological value (Table 5).

3) Water:

The fluid loss in the form of sweat in our environments, can be as high as 4 litres during the shift (Table 2). If water is drunk only to satiate thirst, there can be still body dehydration. Under such dehydrated condition, the feeling of comfort and through that, the work output will be reduced. Hence voluntary unlimited water intake should be encouraged.

4) Salt:

There is again a misnomer that our workers should be made to consume extra salt to avoid heat disorders, particularly during hot seasons. Since our diet is already rich in salt, there is no necessity for this additional salt consumption (Table 6). This additional salt intake, instead of being helpful, will cause water depletion from the body, in the form of increased urine excretion.

5) Subsidized meal during shift:

Dietary survey among textile workers has shown that because of the largeness of the family size, the per head caloric and nutrient availability becomes less (Table 4). Naturally, if the worker is per force made to consume a subsidized caloric rich meal during shift, this will help in reducing the caloric imbalance in him.

NUTRIENTS CANNOT SERVE AS PROPHYLACTICS AGAINST TOXIC CHEMICALS ETC.

There is a wrong impression among workers as well as managements that by providing milk, the health of those who are exposed to toxic chemicals such as Carbon disulphide, nitrous fumes, lead etc. can be protected. This is wrong.

Even though milk or multi-vitamins can help in maintaining good health, they cannot, in general, serve as prophylactics to protect against the ill-effects of toxic chemicals. This point should not be overlooked.

Table 1(a): Influence of stature on some pulmonary functions and aerobic capacity

Ht. cm.	Wt Kg.	Vital capacity 1_{BTPS}	Maximal Ventilation (exercise) 1_{BTPS}	Aerobic capacity 1_{STPD}/min
120	20	1.8	45	1.2
140	33	2.3	65	1.8
160	50	3.5	80	2.5
180	75	6.0	115	4.0

(Reference - 1)

Table 1(b): Influence of age on some pulmonary functions and on work capacity

Parameters	Age groups						
	21-25	26-30	31-35	36-40	41-45	46-50	51-55
V.C. 1_{BTPS}	3.67	4.09	3.87	3.40	3.39	3.33	3.49
FEV_1 1_{BTPS}	2.99	3.18	3.01	2.56	2.63	2.46	2.46
VO_2 Max 1_{STPD}/min	2.35	2.34	2.27	2.11	2.01	1.97	1.81
Max. rate of work on bicycle ergometer kg. mpmin.	1200	1149	1135	1008	975	1018	904

(Ramaswamy et al 1969)
(Reference-2)

Table-2 Cause-Effect Relationship

Nature of stress	Level to which chronically exposed	Impact on output capacity or health impairment	Ref.
1. Thermal	29.5° to 33°	3% reduction in output for each oC rise over 29.5°C	3
2. Thermal	$26^{\circ}C$ to $33^{\circ}C$ (exptl)	Errors committed during wireless operation, increased by about 40-50%	4
3. Inhalation of cotton dust	Varying concentrations upto 20mg/m	5% reduction in pulmonary functions for each 10 mg/m^3 increase in dust level	5
4. Lead fumes and dust	10 mg to 25 mg per 10 m	Nearly 1% increase in the incidence of symptoms for each mg/$10m^3$ rise in concentration.	6

Table-3 A few cases of Cost-benefit Analysis
(Health effects)

Pollutant/ Stress factors	Improvement- Reduction in the airborne levels	Reduction in the incidence of typically affected cases	Ref.
Lead(Storage) Battery Industry)	From 3.5 to 0.4 mg/$10m^3$	Cases of severe symptoms were reduced from 31 to 5 percent.	6
Carbon disulphide (Viscose Rayon Industry)	From 64.0 to 1-4mg/m^3	29 to 13 percent	7
Silica containing dust (Pottery & Ceramic Industry)	101-200 mppcf to 6-20 mppcf (dust containing around 30% free silica)	47 to 10.7 percent	8

Table 4: Study of Effectiveness of Control Measures

...ustry/Process	Control measure/ improvement	Effect	Ref.
Viscose Rayon	Encasing of machines in the pinning hall	Concentration of Carbon Disulphide reduced by 60% and that of Hydrogen Sulphide by 62%	9
Caustic Soda Plants	Increasing the general ventilation	Concentration of mercury vapour by air was reduced by 58%	10
Pharmaceuticals	Enclosing the granulating machine	Noise level in the adjoining area reduced from 116 to 75dB$_A$	11
	Segregating and enclosing the tablet punching machine.	" " 86 to 76dB$_A$	
Pneumatic Chipping Operation	Chipping height which was low, was raised by 7.5 cm.	1. The cardiac cost of chipping was reduced by 21% 2. Energy cost was reduced by 16%	12

Table 5: Beneficial Effects of Splitting the rest pause

Lifting 40 lb. case from floor level to 20 inch height 6 times a minute.

Schedule A: 10 mins work + 2 mins. rest
Total work 40 mins.
Total rest 30 mins.

Schedule B: 10 mins. work + 7 mins. rest
Total work 40 mins.
Total rest 30 mins.

Heart rate: Counted upto the end of 70th minute

Pattern of rest pauses	Heart Rate Total	Resting	Extra due to work schedule
Schedule A (rest in bulk towards the end)	7069	4900	2169
Schedule B (Rest distributed)	6438	4900	1538

(Reference 13)

Table 6: Eye disorders among dock workers of Bombay, attributable to Occupational Causes

(Different analysis)

Age group	Control group not exposed to occ. hazards		Workers exposed to occ. hazards such as cargo dust	
20 and below	0/3	0%	0/3	0%
21-25	2/38	6	2/26	8
26-30	3/45	7	8/63	13
31-35	7/43	17	4/65	7
36-40	9/48	19	12/53	23
41-45	10/52	19	24/77	31
46-50	9/51	18	36/85	42
51-55	14/25	56	22/50	44
56-60	15/23	65	18/24	75

(Reference - 14)

FIRST - AID LEAFLET

(Instructions for handling emergencies)

SHOCK:

1. Lay the patient on his back
2. Stop bleeding if any.
3. Relieve pain by supporting injured part .
4. Keep the patient comfortable , but not hot. Do not cause sweating.
5. Fluids may be given in small amounts unless the patient is nauseated, unconscious, likely to be operated on, or has an abdominal wound.
6. Reassure and cheer up the patient.

WOUNDS:

1. Stop the bleeding by any one of the following methods.
   (a) Direct pressure;
   (b) Direct finger pressure into the wound in cases of larger bleeding wounds;
   (c) Tourniquet (seldom needed) - use only as a last resort.
2. Avoid touching the wound with hands or unsterile material.
3. Clear the wound with running water and surrounding area with soap or spirit with clean gauze washing away from the wound. Apply ready-made adhesive gauze bandage or sterile gauze and roller bandage as needed.
4. Keep the patient quiet; raising the extremity if it is the bleeding part. Give no stimulants.
5. Never apply antiseptic ointment, lotion or iodine or germicide to the wound.

ABDOMINAL WOUNDS:

1. No time must be lost in sending the patient to the hospital.
2. Keep the patient flat.
3. Give nothing by mouth.
4. Maintain warmth.
5. If intestines protrude from the wound do not attempt to touch or replace them.
6. Apply sterile dressing and binder as for wounds.
7. Provide careful, immediate transportation to the hospital.

EYE-WOUNDS:

1. Removal may be attempted if foreign body is not embedded.
2. Do not apply oil or ointment.
3. If there is a foreign body embedded in the eye-ball, send the worker immediately to the doctor after applying pad and loose bandage

....2.

CHEMICAL BURNS OF THE EYES:

1. Immediate washing of the eye at least for fifteen minutes is of great importance.
2. Apply sterile bandage and send the worker immediately to the doctor.
3. Neutralizing agents or ointments should not be used.

SUFFOCATION:

1. Remove the patient from the source of danger
2. Make a rapid examination to ensure that the air passages are free, and to clean them if necessary.
3. Restore natural breathing by artificial respiration, if breathing has ceased.

ELECTRIC SHOCK:

1. Remove the patient from the source of danger
2. Make a rapid examination to ensure that the air passage are free, and to clean them if necessary.
3. Restore natural breathing by artificial respiration, if breathing has ceased.

INSENSIBILITY:

1. Send for a doctor if possible; pending his arrival -
2. Where the patient's face is pale, lay him flat and face downwards with his head turned to one side. If his face is flushed or blue, raise and support the head and shoulders.
3. Control any serious bleeding.
4. Loosen any tight clothing and let him have plenty of air.
5. Do not give anything by mouth
6. If doctor is not available send the casualty to hospital.

BACKBONE (SPINAL) FRACTURE:

1. Transport on a rigid frame. This frame may be improvised by using available boards or a door.
2. The rigid frame may be placed on a stretcher for transportation.
3. If a firm frame cannot be improvised, transport patient on abdomen on a stretcher made of canvas or blanket.
4. In neck fracture cases it is much better to get a doctor to the scene for danger to life is great.

BRUISES :

1. Cold applications at first - 24 - 48 hours
2. Later heat - after 24 - 48 hours.

BURNS:

1. Act quickly
2. Put the affected part in cold water.
3. Pour the water over burns that cannot be immersed.(Cold water relieves pain, reduces fluid loss).
4. Cover with a sterilized dressing.

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INDUSTRIAL SAFETY,HEALTH AND WELFARE CENTRE

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INDUSTRIAL VENTILATION

OBJECTIVE :

The functions which ventilation has to perform can be classified as:

i) to maintain the oxygen content of the air and to prevent CO2 concentrations from rising,

ii) to prevent objectionable body odeurs,

iii) to prevent harmful concentration of aerosols, and

iv) to maintain reasonable conditions of comfort for operators.

Of these, the first two functions are insignificant in industrial environments in that the requirements of air for achieving the objectives in items (iii) and (iv) will far outweigh the requirements for the objectives set out in items (i) and (ii).

The chief need for ventilation is to maintain the body heat balance and to provide reasonable conditions of comfort. The heat balance of the body can be expressed by the equation:

$$M = E + R + C + S$$

whereM = Rate of metabolism

E = Rate of heat loss by evaporation

C = Rate of heat loss by convection, and

S = Rate of heat storage in body

The standard rate of metabolism for sedentary adults is about 100 Kcal/hr. while for adults occupied in very heavy work, it is much as 775 to 1000 kcal/hr. Factors determining the imposed thermal stress, as could be seen from the given equation are (i) air temperature, (ii) temperature of surroundings, (iii) humidity, (iv) air velocity, (v) degree of activity and (vi) clothing worn.

Ventilation should aim at:

i) keeping the air temperature of the work room low enough to enable body heat to be dessipated by convection,

ii) preventing excessive humidity so as to assist body heat loss by evaporation, and

iii) regulating the rate of air movement so that loss of body heat by convection is facilitated.

From the foregoing discussions, it is evident that ventilation has to perform three functions - firstly to supply sufficient quantity of fresh air, secondly to distribute the air satisfactorily throughout the workroom and thirdly, to maintain reasonable conditions of comfort for the operators. These functions are interrelated and are to be considered in the design of factory buildings from the point of view of ventilation. Although every case has to be considered according to its own characteristics and conditions prevailing, the amount of ventilation required is oftened governed chiefly by physical consideration for controlling air temperature, air distribution and air velovity and depend generally on the following factors:

i) size (including height) and type of room or building and its usuage,

ii) duration and type of occupants and their activities,

iii) heat gains from sun, hot manufacturing process, machinery and occupants,

iv) temperature conditions desired inside the building in relation to outside conditions prevailing, and

v) the operation of the ventilating system.

Ventilation systems are divisible into two main groups, (i) natural ventilation and (ii) mechanical ventilation. Many times mechanical ventilation is employed to augment the ventilation obtained by natural means.

NATURAL VENTILATION:

Principle

Forces which operate to induce natural ventilation in buildings are two: (i) pressures exerted by the outside wind, i.e. wind action and (ii) the temperature difference of the air within and without the building, i.e. the thermal heed causing chim-ney effect. The force exerted by wind strikes a building, " positive pressure" is created on the windward side of the building, and " negative pressure" on the leeward side, i.e. at the lee of the building, at the sides and over the roof immediately behind the windward wall. If adequate openings, suitably placed in relation to these pressure areas, are available, it should be possible to combine the effects of the varying wind pressures and move air rapidly through and within the building. At or near the windows, the rate of air movements induced owing to the pressure difference will be high, but at the centre the air movement will be considerably diminished. It is, therefore, important that such areas of low air movement should be eliminated by increasing the proportion of effective ventilating openings in the wall and roof and by suitable orientation of the building in relation to the prevailing winds.

Thermal head sets up the usual convection currents with the movement of warmed air upwards to leave openings in or near the roof, and be replaced to cool air entering at a lower level.

Cross Ventilation:

In factory buildings where the widths are not large, good cross ventilation can usually be obtained by the provision of large and suitably placed windows or combination of windows and wall ventilators for the inflow and outflow of air. Since the prime consideration designing buildings from point of view of ventilation is to provide reasonable conditions of thermal comfort, air movements will have to be sufficiently high during summer months to bring down the effective temperature of the factory environments. Considering the psychological principles involved in man's reaction to hot weather, it is felt that air movements of 45 to 60 metres (150 to 200 ft.) per minute should be aimed at to improve comfort.

Area of openings :

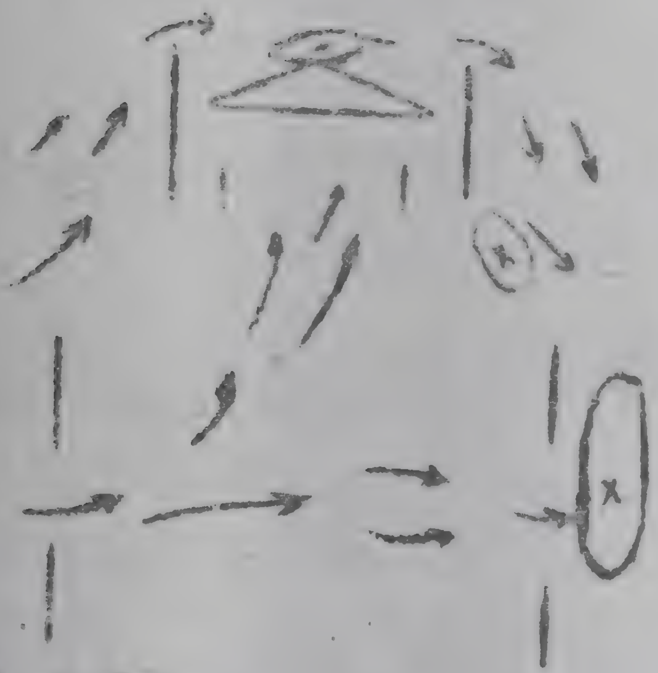
The method of calculation of ventilating area based on number of occupants does not have a sound basis for the following reasons. As pointed out earlier, the main consideration in providing ventilation in an industrial building is to maintain conditions inside the work rooms which assist the maintenance of thermal equilibrium of the body and also afford reasonable comfort to workers. The heat load from persons within the room is generally very small considering the heat gains from other sources such as sun, hot manufacturing processes, machinery and lights and therefore, it is not sound to base the rate of ventilation on the number of occupants.

It is difficult to evolve a common standard which will be applicable to all cases. For factories where there is no excessive heat gain either due to manufacturing area of 15% in arid regions and [illegible]5% in humid regions. It is also a good working rule that about half the ventilating area should be between floor level and a height of 2.25 meters (7' - 6") from the floor and so arranged that there will be passage of air across all parts of the building. The rest of the ventilating openings may be provided under the eaves or at the glazing of the roof.

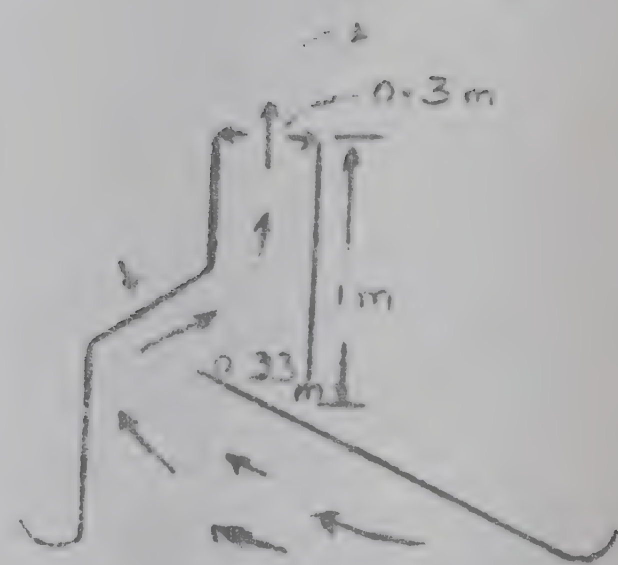
Roofed Ventilation

Cross ventilation by provision of windows and wall ventilators is suitable only for narrow factory buildings or work places. In large buildings roofed ventilation would be required. The most common means adopted for effecting ventilation through ventilating areas in the roof is by natural ventilation induced by thermal head causing chimney effect. However, the chimney effect is counteracted when the wind blows straight against these roof openings. Such interference can be prevented by suitably altering the design of the ventilating openings in the case of pitched-roof and saw-tooth-roofed buildings. In the case of monitor roofed buildings, the ventilators in the glazings should be of opening and closing type so that the ventilators on the windward side can be kept closed to prevent direct draughts of air interfering with upward flow of air.

The following sketches show the modified type of roof ventilators.



MODIFIED PITCHED ROOF



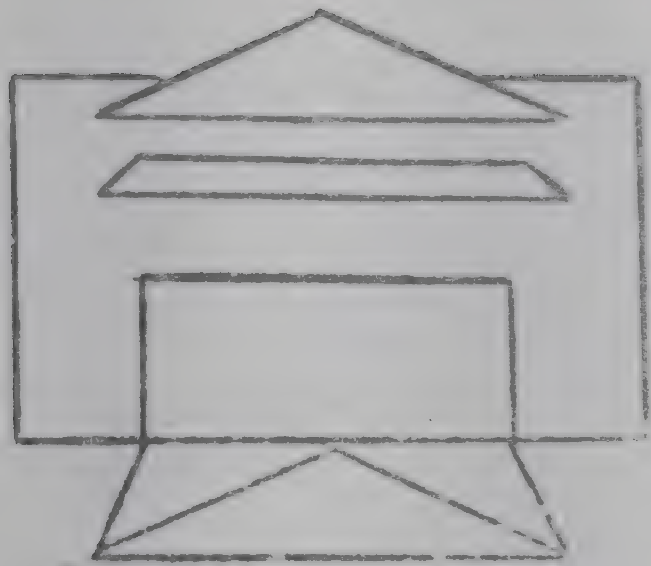
MODIFIED SAW TOOTH ROOF

Wind action in any directions does not cause interference with chimney effect but supplements ventilation by creating suction through wind jump.

Cowl Type Roof Ventilators:

Natural extraction of air from buildings can be obtained by the provisions of cowl type roof ventilators also. The performance of the roof cowls depends on the difference between the temperature of the external and internal air, on the height of these ventilators above air intake, on the velocity of the external wind and on the cross-sectional area of the ventilators.

An example of a modern roof cowl is the Robertson Ventilators shown in figure given in the next page. As will be noted the circular wind band around the ventilator causes a wind jump resulting in an upward draught of air from inside the building which supplements the ventilation due to chimney effect depending on the height of the ventilator above the intake openings in the side walls.



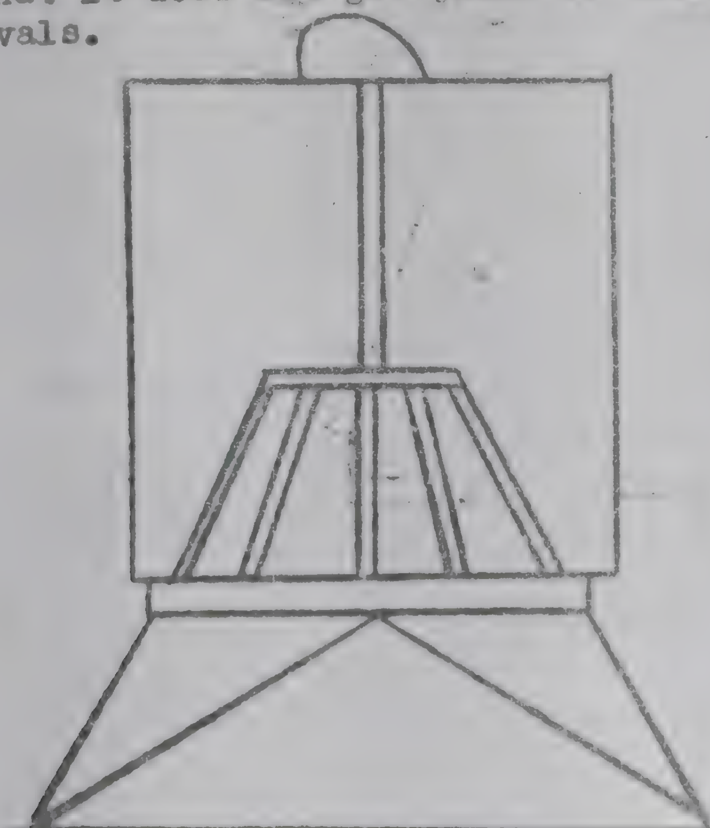
COWL TYPE ROOF VENTILATOR

Capacity of this of ventilator for a 60 cm (24 in.) diameter cowl in relation to temperature difference, height of ventilator above intake and wind velocity is given by the equation:-

$$Q = A(3.3 \sqrt{5.91\ H\ (t1 - t0)} + 0.0035V.$$

Where Q is expressed in cu. metres/min., A is the cross-sectional area of the ventilator in sq. metres, H is height of the ventilator above the inlets in metres, t1 and to are the internal and outside temperatures in oC, and V is the wind velocity in kilometres/hr.

Another type of cowly ventilator is the rotating cowl ventilator shown in figure below which is intended to produce the same effect. The type illustrated is carefully balanced and provided with a large reservoir for lubricant so that it does not get jamed or seized and needs attention only at long intervals.



ROTATING TYPE COWL VENTILATOR

MECHANICAL VENTILATION

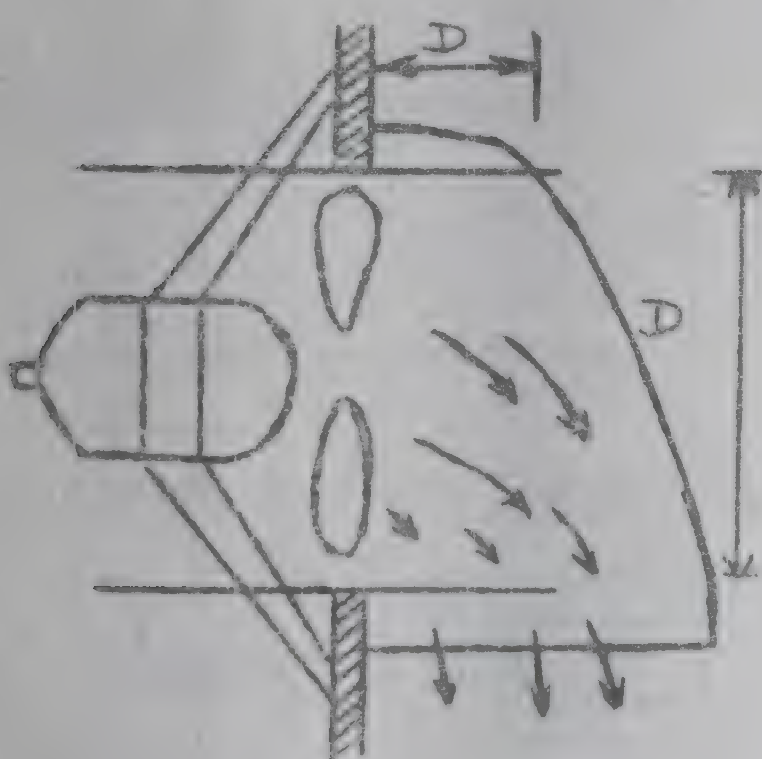
Ventilation by natural means is not always practicable in which case ventilation by mechanical means is resorted to workrooms or work places where ventilating openings cannot be provided due to their situation with respect to surrounding buildings or due to the process carried on in them and large buildings where natural meansfail to provide the necessary ventilation, are examples where mechanical ventilation would be necessary. Mechanical ventilation is brought about by either one or both of the following two methods:

i) Ventilation through windows or other openings owing to the suction created by the exhaust air, and

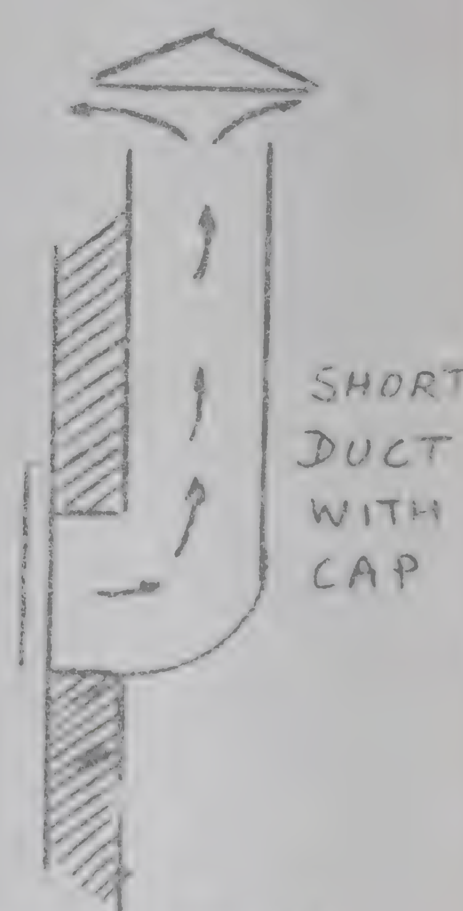
ii) Positive ventilation by means of a fan or blower.

Exhaust Ventilation:

Ventilation by this system can be effected in the case of narrow rooms by providing exhaust fans at suitable intervals in one side wall and adequate inlet openings in the opposite wall. Care should be taken to see that adequate inlet openings are provided so as to minimise draught caused by high inlet velovities, and to avoid drop in efficiency of the system. The total inlet area should be at least three times the total disc area of the fan. The exhaust fans should be provided with wind shield on the outside of the wall so that wind pressure may not decrease their efficiency. They should, atthe same time, not restrict free discharge of air. Effective protection from wind can be given by having the fans to discharge under protection at the top. The arrangements mentioned above are shown in the following sketches:



WIND SHIELD



SHORT DUCT WITH CAP

Windows and other openings near the fans should be kept closed as otherwise fans will draw air supply from these openings and thus cause short circuiting which is a very common fault with this type of ventilati

Exhaust ventilation can be provided in larger workrooms by having a fan of adequate capacity extracting air from the interior of the rooms by means of suitably placed ducting.

Exhaust ventilation is often used in combination with natural ventilation so as to effectively ventilate work rooms where natural means alone will not be sufficient to provide adequate ventilation in all portions of the rooms.

Plenum Ventilation

Compared with extraction system, plenum ventilation afford more complete control of atmospheric conditions inside the factory. Plenum system is useful where extraction system cannot be readily applied as in very large departments or workrooms. In this system of ventilation, air is forced into the building by means of a centrifugal or other type of pressure fan and is distributed through suitably placed ducts. This system has various advantages. The supply air can be conditioned, if desired, before it is passed into the plenum chamber and ducts. The slight positive pressure set up with the building prevents inward leakage of warm or cold outside air. The volume of air movement that can be set up by plenum ventilation is many times more than what is possible by exhausting. Also better dilution of contamination and lower operator exposure can be achieved with a well designed supply system than with exhaust, since the supply can be directed to the important sources of contamination and good circulation is effected without accessory equipment. Air supplied from supply inlets or the location of the supply should not be such as to disturb the air flow at local exhaust hoods. Ducting should be so designed and laid as to convey the air as directly as possible at suitable velocities at the same time due regard to economy of material and power. Ducts should be smooth and as straight as possible. Sharp bends and sudden enlargements and contractions should be avoided. For changing the direction or dimensions of a duct, the angle between the sides and axis of the duct should never exceed 30° and preferably be not more than 15°.

The velocities depend upon the nature of the installation and the extent of quietness required.

The air inlets should be designed and the discharge velocity should be such as to cause eddy currents and to remove " dead spaces". The air velocities should not be excessive to the extent of interfering with the manufacturing process or of causing unpleasantness, but there should be currents of sufficient strength and variability so as to provide a pleasa environment. Good distribution is often achieved by using diffusers at the inlets. Another method of distribution used in industry with plenum system is to deliver air in obtained and more distribution of the air caused. Excessive draughts can be avoided by the nozzles discharging air horizontally at a little height above the heads of the workers.

Combined plenum and Extraction Systems:

Better control of ventilation is obtained by this system of ve[illegible] lation, in wider buildings, by supplying appropriate quantities of [illegible] and at suitable velocities at the required areas by plenum ducts an[illegible] extracting the air into return ducts and sometimes recirculating th[illegible] air after properly mixing it with cooled fresh air, completely sati[illegible] ventilation can be obtained. In a combined supply and exhaust syste[illegible] is preferable to provide slightly excess of exhaust, if there are [illegible] occupied spaces and slight excess of supply, if there are no such [illegible]

Mechanical Roof Ventilation.

Powerful mechanical roof ventilators of unit type are increasin[illegible] being used for augmenting natural ventilation in buildings with larg[illegible] widths or where the heat load is very heavy. When these are provide[illegible] it is important that the openings within their area of influence sho[illegible] be closed to avoid short circulating exhaust fans exercise very litt[illegible] influence beyond a velocity contour of about 15 m/min.(50ft,/mn.) which is just a short instance from the fan.

The amount of Air Required:

a) Based on Heat Gain: The amount of ventilation required can be cal[illegible] lated on the basis of total heat gains from sun, not manufacturing p[illegible] machinery and occupants within the buildings, determining in advance [illegible] temperature rise which would be acceptable. The volume of air requir[illegible] in removal of sensible heat gain (in kcl. per hour) can be calculated [illegible] from the formula.

$$Q = \frac{Kcal/hr. \times .0577}{\text{Temperature rise in } ^{\circ}C} \quad \left(\frac{B.Th.U./hr}{\text{or } Q = 1.08 \times \text{Temp. ris}} \right.$$

Where Q is the Volume of air in cubic metres/min.(or where Q is the volume of air in cu.ft./min.)

In majority of the cases, the sensible heat load will far exceed [illegible] latent heat load(resulting from moisture given off by occupants and p[illegible] so that the capacity of the ventilating equipment can be calculated i[illegible] most cases on the basis of the above equation.

Though very little data exists on allowable temperature rise val[illegible] air change for comfort in summer months, the values given in Table VI[illegible] serve as good rule of thumb.

TABLE VIII

Allowable Temperature-Rise Value

Roof elevation in metres	Rise in oC
12 (40 feet)	6.7. to 11.1 (12 to 20 oF)
9 (30 feet)	4.4. to 6.7 (8 to 12 oF)
6 (20 feet)	2.8. to 4.4 (5 to 8 °F)

Conditions are limited to a) supply air outlets not more than 3 or 4.5 metres above floor; b) Light or medium heavy manufacturing operations and c) Freedom from radiant heat.

* Temperature rise = roof exist temperature - outdoor temperature.

The above values refer mainly to roof exit. temperature rise and are not indicative of floor temperatures. The recommended maximum allowable temperature rise for an air stream as it leave the grills and reaches the working level is 1.7 °C (3.0 °F).

b) Based on Contaminants: Though general ventilation is not appropriate methods in dealing with toxic chemical contaminants arising out of processes, this type of ventilation (dilution ventilation) is used generally to control contaminants such as the vapours from less toxic solvents. The amount of ventilation required for dilution can be determined if the amount of the contaminant escaping into the environment per hour and its toxicity is known.

Cooling of Supplied Air:

The quantity of air required for ventilation as indicated above could be reduced, if the outside air is cooled before the air is discharged into the building. Refrigeration is very expensive, however, evaporative cooling may be adopted with advantage particularly in arid regions where summers are dry with low et bulb temperatures.

CONTROL OF HEAT EXPOSURES:

Besides providing good general ventilation, it would be necessary in many industrial situations to adopt other additional means for giving relief from heat to the workers.

Control at Source:

The first obvious step for mitigating the effects of heat is to eliminate the heat sources wherever possible or to segregate them. Some of the hot process equipment could be placed out of doors with only a protective roof. The location of furnaces in separate wings rather than in a large single building will simplify the problem of supplying air for general ventilation. These wings may have high roof to provide better chimney effect for the removal of hot air over the furnaces.

Local Exhaust Ventilation:

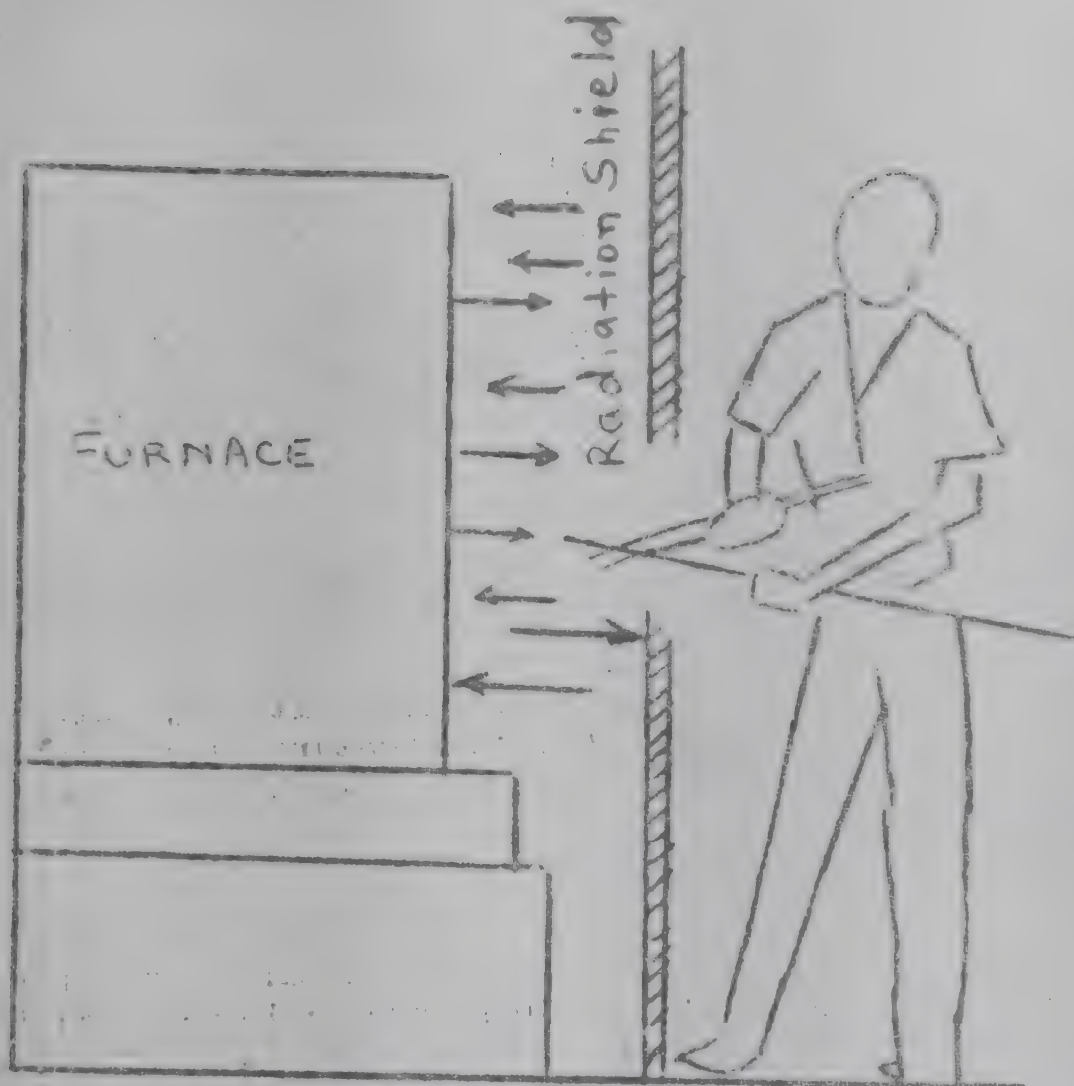
Another method of removing the heat from the source is by providing ventilated enclosures such as canopy or exhaust hoods by which natural convection column of heated air rises from a hot process environment. This will minimise the temperature rise in the space around the hot proc

Insulation:

The insulation of furnaces and other heat producing equipment will not only reduce the amount of heat exposure but also result in the conse saving in fuel consumption. If all the heat produced by a process is released into a work room and the heat production is constant, no amount of insulation around the process will bring about reduction in heat expo The insulation will be of value only when heat produced has several avenues of escape, the dissipation into the workroom being only one of these. In such cases, a combination of insulation and exhaust or gravit ventilation will often be quite effective.

Control of Radiant Heat:

In some industries commonly referred to as " hot " industries, the frequency of very hot objects and surfaces such as furnaces, ovens, furnace stacks, molten material, hot ingots of metal, castings, and forgings is such that the major environmental heat load is in the form of radiant heat which may be several times greater than the convective head load. No amount of ventilation with or without air cooling will reduce the heat exposure since air temperature has no significant influence on the flow of radiant heat. The only effective control is the direct one of decreasing the amount of radiant heat impinging on the exposed workers. This can be accomplished by either lowering the surface temperature of the hot equipment (by insulation or by water cooling), or by radiation shielding. A shield is simply a sheet of material, opeque to the infra-red waves (or essentially so) placed between a hot object such as furnace and work surroundings. The shield should not contact the radiating surface and the presence of a ventilated air space between the hot object and the shield to avoid heating of the shielf by conduction and to remove the heated air in between. Materials best suited for radiant heat shields are those with surfaces that maint the high reflectivities for radiant heat and low emissivities under plant conditions. Sheet aluminium has these properties, it is the most common material used for radiation shielding.



HIGH REFLECTING SHIELD

Roofs of corrugated iron sheets or of asbestos cement sheets get heated by sun in hot weather and act as constant sources of heat, the major portion of which is radiant heat. Control of this type of heat exposure may be achieved by lowering the surface temperature of the roof by one or more of the following methods.

i) Insulating the roof by providing a layer of material of low conductivity,

ii) Shielding by the provision of a false roof or ceiling with sufficient air space ventilated to outside atmosphere,

iii) White-washing or white painting the exterior surface of the roof,

iv) Spraying of water intermittently over the roof to cool it by evaporation.

Openings and glazings in the walls and roof through which sun's rays could directly penetrate in summer should as far as practicable be screened.

Local Relief:

In certain situations when a general reduction of heat exposure throughout the plant is not feasible and all the above methods such as exhaust ventilation and radiation shielding have not brought down the thermal environment to a tolerable degree, relief may be provided locally

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i.e., at the work-places by surrounding the exposed workers with an acceptable thermal environment by providing positive ventilation. The following three methods may be employed depending on the work situations:

a) Providing a complete enclosure around the worker with a separate ventilation in order to maintain cooler working conditions. This may be in the form of air-conditioned control room, small shelter booth, or ventilated crane cab.

b) Surrounding the worker with a relatively cool atmosphere by a direct supply of air introduced at the working level or over a small area of the plant.

c) Directing a high velocity air steam at the worker when the air is capable of absorbing heat i.e. either its dry bulb is reasonably lower than the body temperature or its humidity is low enough to allow evaporation of sweat.

Personal Protection and Shielding:

In certain operations, such as glass enameling particularly by dry process, the workers may be required to work within reach of hot objects which may be at temperature of 800°C (1472 °F) or higher and the time required for operation may reach 20 minutes. In such situations, protective clothing and protective shielfs of heat reflecting type can be used for controlling heat exposures. The protective clothing is generally made of aluminized asbestos cloth usually backed up with felt or other insulating material. Aluminised fibre glass, aluminised cotton duck or aluminium sprayed asbestos have also proved effective. The operator may be equipped with mitts, leggings, aprons, jackets, helmets, and special arm sleeves according to specific operations. The protective clothing must not be very heavy and should be flexible enough to permit free movement, and only those parts of the body which are facing the hot objects need be covered.

Protective shields faced with aluminium when interposed between areas of high radiant heat exposure and workers have also proved successful in many cases.
These shields consist of a wood frame backed with light gauge metal or plywood and then covered with aluminium foil of sufficient thickness to withstand wear and tear. The shields, which may be portable or semi-portable according to the work situations, have sometimes been preferred to use of blowers or fans and personal clothing.

LOCAL EXHAUST VENTILATION

Local exhaust ventilation is one of the most important methods of control of atmospheric contaminants. The principle is to great a sufficient movement of air to withdraw contaminants at point of

origin and convey them to a safe point for disposal. An exhaust consists of four major parts:

1 Hoods or enclosures near source of contaminants at point of origin and convey them to a safe point for disposal. An exhaust system consist of four major parts.

1. Hoods or enclosures near source of contaminant,
2. Ducting to connect hoods into system,
3. Collection equipment,
4. Fan

Dust is usually more difficult to control than gases, vapours, mists, and fumes. Dusty operations tend to project particles so that the hood must provide velocities sufficient to draw them into the exhaust system. Exhaust hoods should enclose the process as completely as possible or the hood should be located to take advantage of the directional effects of the dust flow. Dust removal systems generally require higher air velocities and ducts of heavier gauge metal than those designed for gases. Hoods or enclosures may be in the form of booths, canopies, lateral hoods, down drafts through grill openings below the process, or slot-type hoods. The object is to remove the contaminants without drawing it through the breathing zone of the operators and with minimum interference with processing.

Ducts connect the hoods to the central fan, distribute the air flow in direct proportion to the requirements of each inlet, and maintain adequate pipe velocity to convey the contaminant to the point of discharge. The system should be balanced so that each hood draws the proper amount of air. Areas of branch pipes and main ducts can becalculated to five correct air velocities throughout the system.

Material used for ducts must resist abrasive action of dust or corrosive effects of gases and vapours. Sharp turns in ducts take extra power and cause a large pressure drop. Traps with clean-out gates should be provided at the bottom of vertical runs, and clean-out gates at regular intervals on the bottom side of hortizontal runs.

Fans should have a capacity slightly higher than calculated requirements to allow for leakage in the system, accumulation of material on fan blades, and similar difficulties.

Where the contaminant is hot and has a natural tendency to rise and the operation can be provided with an effective enclosure type hood , natural draft ventilation is often satisfactory.

Low volume high velocity exhaust systems can be used advantageously to extract contaminants dispersed by the use of portable tools.

Collection Equipment:

A suitable collection equipment for collection of the contaminants is essential in exhaust systems to avoid pollution of outside air. The equipment to be chosen will depend upon the type of contaminant to be collected, the quantity of it and the degree of efficiency required. The types of collecting equipment commonly used are a) Dry type centrifugal collectors, b) Scrubbers, c) Electro-static precipitators and d) Fabric filters.

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PHYSIOLOGICAL ASPECTS OF MAN AT WORK

By

P. N. SAHA*

The branch of science that deals with the physiological aspects of man at work is known as 'Work Physiology'. It has a basic part, a branch of human biology, and an applied part, called 'Industrial Physiology'. The objective of Industrial Physiology is, through the application of physiological research methods, to get useful information about working conditions in industry, how they are today and how they can be improved in order to make work more human and comfortable and to increase productivity without straining the worker unduly.

During muscular work physiological functions change from the resting level. Heart rate, blood pressure, cardiac output, respiration, pulmonary ventilation, oxygen uptake, carbondioxide production, chemical composition of blood and urine, body temperature, rate of perspiration, etc. increase. They come back to resting level when the work stops. The period during which the work continues is known as "Work Cycle" and the period during which the physiological functions return to the resting level is known as 'Recovery period'.

By measuring one or more physiological variables during activity, it is possible to determine in what degree the working level differs from the resting level. This gives an estimate of the physiological stress experienced in performing a given task. When the activity ceases, it is possible to follow the return of the same variables to the resting level and to determine the duration of the recovery period, at the end of which the individual has returned to his pre-activity physiological equilibrium. In order to evaluate total physiological expenditure, one must consider physiological reactions both during the work and during the recovery period. A complete work cycle includes physiological cost of work plus the physiological cost of recovery.

Now let us review the major 'Physiological factors' involved in muscular activity.

Factors involved	Role played
1) Fuel	All the three classes of nutrients - carbohydrates, fat and protein provide energy for muscular work. Carbohydrate and fat are mostly used by the working muscle, while little protein is utilised directly as fuel.

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Factors involved	Role played
2) Respiratory Quotient (R.Q.)	Oxygen is used up and carbon-dioxide is given off during muscula work. The ratio of the amount of carbondioxide produced and the amou of oxygen consumed is known as 'Respiratory Quotient'. RQ of carb hydrates is 1.0, fat 0.7 and protei is 0.8. The RQ provides informatio about the amount of each food-stuff utilized and energy obtained therefr during muscular work. For a mixed diet RQ is 0.85 at rest, it rises during work and falls during recove
3. Role of oxygen :	
a) Demand	Oxygen is necessary for normal life and activity. The cells of the body require oxygen for oxidative processes from which the energy is deriv During muscular work the demand of oxygen is increased as there is dem for more energy.
b) Requirement	At rest the requirement of oxygen varies from 150 to 250 cc. per min. During very hard work this need may be increased to 10 times or more.
c) Supply	When the supply of oxygen is adequat muscular work is carried out without any formation of lactic acid in muscle (aerobic process). But if the supply is inadequate, lactic aci is formed in the muscles and goes into circulation resulting in an increase of lactic acid content in the blood(anaerobic process). The estimation of lactic acid in blood during work and recovery gives an indication as to the stress of the muscular work.
i) Steady state	During moderate and uniform exercis the intake of oxygen rises graduall in a minute or two it becomes almos stationery and remains at this leve throughout the period of exercise. The oxygen intake is equal to the oxygen expenditure at this state, which is known as 'steady state'. Other bodily functions such as respiration, heart rate and lactic acid production also maintain a steady level.

Factors involved	[illegible]
ii) Oxygen debt	When work continues with anaerobic process, the oxygen debt is incurred which is paid during the recovery period. The ability to run as oxygen debt will increase the work capacity. Accumulation of 7 gm. of lactic acid will create 1 lit. oxygen debt.
4) Cardio-vascular functions.	The cardiovascular system comprising of heart and blood vessels plays a crucial role during muscular work.
a) Cardiac output	Volume of blood expelled by the heart per minute is a product of heart rates & stroke volume. It increases during muscular work.
i) Stroke volume	Amount of blood pumped with each heart beat. It also increased during muscular work.
ii) Heart rate	It increases during muscular work. The maximum pulse as high as 200 per min. or more has been observed during work. The recovery takes place as soon as the work stops.
b) Blood pressure	Systolic and pulse pressure (difference between systolic and diastolic) increase with the workload. The change of diastolic pressure is insignificant.
5) Respiration	The purpose of respiration is to provide oxygen for metabolism of the body cells and to eliminate carbon-dioxide resulting from oxidation. It increases during muscular work.
a) Tidal air	Amount of air exchanged in every fact of normal respiration. It increases during muscular work.
b) Pulmonary ventilation	The volume of air expired per minute. It is a product of 'tidal air' and 'respiratory rate'. It is increased during muscular work in proportion to the intensity of muscular activity. The increase is brought about by increasing both the 'tidal air' and the 'respiration'. The increased pulmonary ventilation during work is due to the increased demand of oxygen. Pulmonary ventilation as high as 100 lt./min. is sufficient for maximal oxygen consumption.

Factors influencing	Comments
6) Body temperature	Body temperature in health and during rest remains fairly constant with a normal fluctuation of not more than ± 1°C. Body temperature increases during work and it is a function of rate of metabolism in cool and comfortably warm climate.

Methods of measurement of work output:

There are two principal methods for measurement of work output expressed in terms of energy expenditure.

1) Direct calorimetry in which the heat produced by the subject is measured directly in a human calorimeter.

2) Indirect calorimetry a) The closed-circuit method and (b) the open circuit method in which the subject's respiratory exchange (oxygen consumption and carbon dioxide production) is determined and is used as a basis for calculating energy output.

Calculation of work output

Data required: 1) Oxygen consumption during the work and
2) Caloric equivalent of oxygen.

If RQ is known, the calorific value of one litre of oxygen can be obtained. It varies from 4.686 to 5.047 Kcal. depending on the type of food stuffs burnt inside the body to supply energy for the performance of work.

Instruments used in measuring the [illegible]

1) Bicycle Ergometer, (2) Treadmill, (3) Douglas Bag, (4) Gas Meter (Dry and Wet), (5) Respirometer, (6) Respiratory Gas Analyser, (7) Benedict-Roth Spirometer or any type viz. [illegible] Spirometer.

Units of physical work: It is measured in Kcal/min.
1 Kcal/min. = 0.0[illegible] H.P. = 70 Watts (approx.)

Factors influencing the physiological reactions during muscular work

Factors influencing	Comments
1) Intensity of muscular activity	
a) Cardiovascular reactions	Exercise of varying intensities influences the pattern of cardiovascular reactions.
b) Aerobic work capacity	During exercise aerobic work capacity increases with increasing work load and reaches maximum value at a particular workload (maximum oxygen uptake capacity).

Factors influencing	Responses
2) Age	
i) Aerobic work capacity	The maximum oxygen uptake capacity diminishes progressively after 25 to 30 years of age.
ii) Heart rate responses	Maximum pulse rate declines with increasing age. During sub-maximal work pulse rate is higher in older than in younger people at a given level of oxygen intake.
iii) Pulmonary ventilation	Maximal pulmonary ventilation increases with increase in age upto 30 years, thereafter the value declines.
v) Blood lactic acid concentration	During performance of standard work its level in blood is shown to be higher in older people.
3) Body build	The physical work capacity (maximal oxygen uptake) is increased with increase in body size for young healthy persons with normal proportion between body weight and height.
4) Sex	
a) Aerobic capacity	The aerobic capacity is 25 to 30% lower in woman after puberty: before puberty it is nearly the same in both the sexes.
b) Heart rate	At a given level of oxygen uptake, the heart rate is higher in women. Maximum pulse rate is about the same for males and females. During sub-maximal work, the heart rate in women is considerably higher then that of the man. A workload that is easy for the man may perhaps put a greater physical strain for the women.
c) Pulmonary ventilation	Maximum pulmonary ventilation upto and including the age of 13 is almost the same in both the sexes: for adults, it is less in females.
d) Blood lactic acid concentration	During a standard work women show higher lactic acid value than men. But the maximum of both the sexes is almost the same upto the age of 25 years.
5) Physical fitness	
a) Aerobic capacity	For the same task, the maximum oxygen uptake is higher in persons with low physical fitness.

Factors influencing	Responses
b) Pulse rate	For the same task, the pulse rate during work is slower in the more physically fit subjects, but the relative acceleration (expressed in per cent of resting pulse) is greater in their case,
c) Respiration	Persons with high-physical fitness breath more economically than the ones with low physical fitness.
) Nutrition	Caloric requirement increases with the amount of work. Inadequate caloric intake reduces the amount of work output.
Training	
a) Heart rate	The heart rate becomes more efficient with the training and while beating less frequently is able to circulate more blood.
b) Stroke volume and cardiac output	Increased during muscular work
c) Blood pressure	During prolonged muscular effort there is a progressive fall of systolic blood pressure in an untrained subject leading to exhaustion. Training improves conditions.
d) Cardiovascular recovery process	Improves by training. Heart rate and blood pressure of the better trained individual return more quickly to the pre-work level.
e) Respiratory responses	It also changes during training
f) Aerobic capacity and lactic acid in blood.	Training improves the aerobic work capacity. Muscular work with an adequate supply of oxygen becomes greater with training. Higher level of work can be performed with little accumulation of lactic acid. Training progressively reduces the accumulation of lactic acid in blood for the same task.
Temperature and humidity of the work environment	Unfavourable environment, especially hot humid condition and high surrounding temperature, imposes physiological load on the individual which is in many cases longer than that from thw workload he performs. If the total physiological load does not exceed optimum limits, the workload increases with the increase in environmental load.

[illegible]	Responses
a) Cardiac output	It increases during work in hot environment because of the necessity of heat dissipation from the core of the body and the consequent acceleration of the pulse rate. The stroke volume is diminished.
b) Recovery heart rate	At high temperature and humidity heart rate after exercise may take longer periods to return to pre-work levels.
c) Body temperature	When the heat dissipation mechanism of the body does not function properly, body temperature tends to rise during work in hot environment.
d) Work output	Seasonal fluctuations in work output are known to exist in heavy work performed in high temperatures. The sequence is: Winter > Spring and Autumn > Summer
e) Posture	Maintenance of standing posture during work for a longer period in hot environment is difficult. Peripheral blood vessels are profoundly dilated: more blood goes to the skin and less is available for the internal organs to function. This explains why some persons experience dizziness on standing for a longer exposure to heat.
g) Clothing	Clothing modifies the cardiovascular functions

Factors responsible for physiological responses to high temperature

Factors responsible	Responses
1) Water and salt content of the body	In hot environment man sweats more. If the fluid loss due to sweat reaches such an extent that it may lead to dehydration, the body temperature and pulse rate greatly rise; the subject feels steadily worse, reaches exhaustion due to dehydration and eventually at a certain stage he may collapse. Under certain conditions of temperature and humidity and muscular work the sweating rate above 4 litres/hr. has been observed. Insufficient salt intake for a considerable length of time may lead to heat cramps after several days work in hot environment. Salt deficiency causes poor physical performance and less tolerance to heat. Salt and water are, therefore, beneficial for man working in hot environment.

Factors responsible	Response
2) Individual Characteristics	In heat
a) Age	Ability to adopt to heat is lessened by age.
b) Sex	Women are less tolerant to heat than men. Under identical conditions women produce less sweat and therefore physiologically less efficient in their evaporative cooling mechanism.
c) Physical fitness	It is correlated to tolerance because of more efficient cardiovascular and vasometer system in the fit individuals.
d) Heat acclimatisation	Acclimatization to heat raises the tolerance to high temperature as well as to work output and makes the subject more comfortabl[illegible] Acclimatization to high heat increases the ability to produce more sweat under the same temperature conditions; to moist heat, it modifies circulatory functions.
3) Workload	In this temperature very hard work imposes excessive physiological strain on the cardi[illegible] vascular and vasometer systems. Continuous work is often impossible under such conditi[illegible]

Physiological effects of continuous work in hot environments

1) Cardiovascular stress	It increases with the increase of surroundin[illegible] temperature. The work performed in hot humid environment produces more strain on the systems.
2) Heart rate	For the same intensity of work the pulse rate increases with an increase in the temperature of the surrounding environment
3) Cardiac cost	An increase in the cardiac cost occurs with a rise in ambient temperature.
4) Blood pressure	The systolic blood pressure may either rise or fall but the diastolic pressure constantly shows a fall.
5) Oxygen uptake	Under warm dry conditions the task may be performed with a slightly lower oxygen uptake.
6) Sweat loss	Sweat loss is greatest under warm dry conditions, warm humid conditions impair evaporative cooling and the body temperature rises appreciably.

Physiological effects of repeated workcycles in hot environment

Factors responsible	Responses
Heart rate	At rest and during work it increases with the increase of the surrounding temperature.
Recovery time	Between the work cycles the recovery time increased with the number of cycles performed and with the temperature. If the recovery is not complete, the heart rate increases progressively as the work cycles are repeated. The accumulated strain increases with more severe environment leading to physiological fatigue.
	Recovery at the final stage after the last workcycle is complete only in a cooler environment; it will remain incomplete if the subject is not removed from heat exposure.
	Longer periods are needed for complete recovery as the workcycles are repeated throughout the shift and as the environmental conditions become warmer.
) Cardiac cost	The cardiac cost of work and recovery increases with the repetition of workcycles and this increase become greater with more severe environmental conditions.
4) Sweat loss	It is greatest when high heat and low humidity are combined. In this case, the evaporative cooling is efficient and thermal recovery is more rapid than with high humidity.

Evaluation of the physiological requirements of jobs

While evaluating the physiological requirements of jobs, the workload on the job and the environment are to be considered. While oxygen intake of energy expenditure estimates the load of physical activity involved in jobs, pulse rate, skin temperature, body temperature, sweat loss, etc. determine the combined effect of the workload and the thermal stress. Work intensity can be classified from all these physiological variables recorded during work.

A proposed classification applicable to Indian workers is given on page No.10.

Evaluation of workload from oxygen consumption or energy expenditure is reasonably accurate and has been in extensive use. Work intensity can also be evaluated by the cardiovascular parameters, viz. pulse rate and blood pressure. For industrial operations, measurement of pulse rate seems to be most direct, simple and often the only method available for evaluating stress of the workers on the job.

Evaluation of cardiovascular stress can also be made from the cardiac cost of work and cardiac cost of recovery. The cardiac cost of work is the total number of heart beats spent above the resting level in order to perform the work. The cardiac cost of recovery is the total number of heart beats above the resting level occurring between the end of the work and return to the pre-activity state. The total cardiac cost of performance is, therefore, equal to the cardiac cost of work and the cardiac cost of recovery. It increases with the increase of work intensity and environmental warmth.

CLASSIFICATION OF JOBS

PHYSIOLOGICAL VARIABLES	PHYSIOLOGICAL LOAD					
	Very light	Light	Mod. heavy	Heavy	Very heavy	Extremely Heavy
O_2 l/min.	<0.35	0.35-0.70	0.70-1.05	1.05-1.40	1.40-1.75	>1.75
E.E. Kcal/min.	<1.75	1.75-3.50	3.50-5.25	5.25-7.00	7.00-8.75	>8.75
Heart rate (beats/min.)		75-100	100-125	125-150	150-175	>175
Sweating rate (ml/hr.)	-	-	180-360	360-540	540-720	>720
Oral temp. °C	-	-	37.25-37.50	37.50-37.75	37.75-38.00	>38.00

Recovery pulse rate: To measure the cardiac cost of work may not be always practicable in industrial work. The recovery pulses give valuable information as to the amount of stress experienced by an individual during work. The onset of the fatigue can also be predicted from the heart rate responses during the recovery period.

A man who cannot recover to a satisfactory level between work-cycles will present increasingly higher physiological reactions as additional workcycles are performed and fatigue will accumulate as the shift progresses. If fatigue is not too severe, it would completely disappear during the interval between two shifts and the man will report for the next shift with resting level of physiological reactions. If a more severe strain is reached, the interval between shifts may not be long enough to ensure complete recovery and the accumulated fatigue over days, weeks or months may occur. It is, therefore, essential to evaluate with reasonable accuracy the recovery time or physiological rest allowances for specific industrial operations.

Evaluation of the worker: The evaluation of the worker is made om the determination of his physical work capacity i.e. maximum ygen intake or aerobic capacity and other associated physiological actions under graded workloads and from the tolerance limit of an lividual to work in heat.

Oxygen intake and oxygen debt as limiting factors in physical exertion

It is possible to predict how long strenuous work can be contin-. It depends on the man's ability to take in oxygen during work, on his ability to accumulate an oxygen debt.

Suppose a man's maximum oxygen intake is 4 L/min, and the imum oxygen debt is 15 litre, how long can he continue in exercise uiring 5 L/min.? The man needs 5 L/min. and can take in only 4 L/min. refore his deficit is 1 L/min. Since the limit of his credit ygen debts) is 15 litre, he can keep on running for 15 minutes.

A man's proficiency in sprinting or long distance running may be explained on the basis of his maximum oxygen intake and the mum oxygen debt that he can tolerate. Let us suppose that we two athletes A & B, of the same body size and the same oxygen irement for the same speed in running. They differ in their mum oxygen intakes per minute and their maximum oxygen debts. we have :

Subject	Maximum Oxygen intake in Litres per Minute	Maximum Oxygen debt in Litres
	3	15
B	5	10

If these men run at top speed for one minute, 'A' will have tres of oxygen, and 'B' 15 litres; therefore, 'A' can run faster 'B'. Suppose that the same men run for twenty minutes at their speed :

'A' will have available (3 x 20) + 15 = 75 litres of oxygen
'B' will have available (5 x 20) + 10 = 110 litres of oxygen.

'B' will have more oxygen 'available' than 'A', he will run .

Factors determining the rate of oxygen intake

Several factors determine the rate at which oxygen may be d to active tissues, and these must be properly co-ordinated egrated with the work of the muscles if the body is to attain ghest efficiency. Four of these factors may be discussed lows:

1) <u>Ventilation of the lungs:</u> Lung ventilation ordinarily increases proportionately to the increase in the intensity of work. By deep breathing the partial pressure of oxygen in the alveolar air may be slightly increased. Since the rate of the passage of oxygen into the blood is determined by the pressure of this gas rather than by its percentage, more oxygen will be picked up by the blood.

2) <u>Oxygen-carrying capacity of the blood;</u> determined by the hemoglobin content of the blood.

3) <u>Unloading of oxygen at the tissues:</u> The oxygen capacity of the blood of people at sea level ranges between 18.5 cc per 100 cc. of blood. Usually about 5.5 cc. of oxygen per 100 cc. of blood are taken by the tissues during a rest period. During activity this may be increased by two or two and a half times.

4) <u>"Minute-volume" of the heart:</u> The rate of blood flow through the body as a whole depends upon the amount of blood the heart pumps per minute. As a rule, the blood output during exercise runs practically parallel with the consumption of oxygen.

<u>Upper safe limit for continuous work</u>

Having know these, the next attempt would be to find out the 'upper safe limit' of physiological strain that can be sustained by the workers for continuous work in industry, day in and day out without any harmful effects on them. One will undoubtedly admit that it is neither desirable nor practicable for an individual to keep him engaged for longer period in manual work employing his maximum capacity. A suitable 'Safety margin' is needed for the efficient work of various systems of the body, particularly the cardio-vascular system, which plays a crucial role during muscular work. The safety margin lies on the levels suggested by Brody (1945) in his book "Bioenergetic and Growth" as follows:-

"Machines are not usually run more than 50% of their capacity and a similar safety margin should perhaps be allowed to man and animals so as to avoid injury or untimely death. The problem of work rationalism is to determine the maximum rate of work that can be carried on day in and day out and still retain vigour to an advanced age".

Studies carried out until now have demonstrated that 50% of one's aerobic work capacity might be considered as 'upper permissible limit' of continuous work. Laboratory experiments have shown that a pulse rate of about 130 beats per minute correspond to an average 50% of one's aerobic work capacity. The 50 per cent level also applies to other physiological functions, such as cardiac output etc.

<u>Physiological fatigue and rest pause</u>

Fatigue is characterised by the gradual decrement of work performance effected by various factors viz. physical, physiological and psychological. It is manifested by gradual increase in physiological strain as the work of the day progresses.

Importance of rest pause in industry

During work in a hot environment, the body gains heat due to ork and external environment. These two factors put a lot of thermal tress on human beings. A continuous work in such an environment may ead to exhaustion, if sufficient cooling of the body is not possible. his also leads to lower efficiency and reduced productivity. Under he circumstances a rest pause is essential for the workers to recover rom exhaustion as well as to increase efficiency and productivity.

Basis of rest pause

The work and the environment produce physiological strain in the orker affecting work performance. Intermittent rest pauses in between ork cycles are necessary to reduce the physiological strain and to ring the worker back to pre-work level as far as possible. This helps im resume work with fresh energy and full efficiency.

Rest allowance in energetic work

According to a German Physiologist (Lehmann), 4800 Kcal per 4 hours represents the upper permissible limit, and about 250 'work' cal. per hour or very nearly 4 'work' Kcal per min. + 1 Kcal. for esting metabolism represent upper limits for more sustained work. ased on these figures, Spitzer (one of Lehmann's co-workers) has rrived at the following formula to calculate rest allowance for orkers engaged in energetic heavy work.

$$\text{Rest allowance per cent} = \frac{(\text{Kcal/min.} - 1)}{4} \times 100$$

The above formula may, however, not be applicable to Indians aving lower body weights and low physical fitness standard. In their ase 3 'work' Kcal per min. will perhaps represent the upper limit for ustained work. The above formula may accordingly be modified to work ut the rest allowances for Indian workers engaged in manual work.

Reducing stress and fatigue - evaluation of improvement

The decrease in the stress upon the workers and consequently the igher efficiency and morale in the plant may be achieved as follows:

1) Reducing energetic workload by partial mechanisation
2) Reducing the heat load by better ventilation or screening
3) Machines and tools can be designed for maximum efficiency with minimum physiological cost.
4) The workers can be chosen on the basis of their physiological fitness for specific tasks.
5) Provision of air-conditioned rest areas
6) Adequate rest periods by adjustment of work rest periods
7) Organising workers team - more workers to be added if the workload in a team is considered very heavy
8) Compensating for sweat loss by adequate intake of water; there should be easy access of cold drinking water close to the workplace.

Selection, placement and supervision of workers

We have already know that the capacity to perform muscular work depends on the physical fitness of the individual and on his degree of training for the specific activity in which he is involved. Even when studying men who appear to be thoroughly adapted to their work and to work environment, wide differences are found among individuals. Even in a fairly homogeneous group of young men, very great difference are observed in the individual capacity for physical performance. It is known that training increases their capacity for work, but that among trained subjects marked differences in working efficiency still persist. In a group work, when those who are physically unfit for a given job are eliminated, the remaining group will have a higher efficiency at a lower physiological cost. Frequently, the removal of those who are physically unfit for a particular job will have a beneficial effect on the morale of the group as a whole, because one must remember that a man who is easily fatigued by his job blames the job rather than his own inadequacy and thus influences the attitude of his co-workers. The workers capacities do not remain static, but are susceptible to changes brought about by aging, illness and mental or emotional problems. It is, therefore, necessary periodically to re-evaluate the physical capacity of the workers with a consequent re-arrangement of the workload. A young, healthy steel worker of 25 years is not the same man at 55 year and probably not capable of doing the same work without paying an excessive physiological cost.

Individual tolerance to heat should be determined by studying the physiological reactions in atmospheres comparable to those encountered in hot industrial situations. 'Heat-intolerant' individual as detected by excessive increases in pulse rate and body temperature, should not be employed in hot jobs.

The stabilizing of the working population in one job for long periods of time, as is operative in our society today, has got certain disadvantages. The foremost among the dis-advantages is the aging factor. Quite often, older employees are not doubt priceless because of their skill, their carefulness and their stability; many light jobs can be done successfully and efficiently by workers in the 50 to 65 age groups, but for moderate and heavy tasks, combined with the stresses, as in the case of the workers in heat and chemical exposure, they may perhaps not be suitable to continue in their job for long periods of time. The recovery takes longer time with advancing age and signs of accumulated strain can be detected clearly in the case of older workers, if the work is repeated.

The heavy task should be entrusted to the young and extremely fit. As those men become older, they should be replaced by younger men and given easier jobs.

ET/

Dr. Sreedhar

Planning and Execution of Occupational Health Studies.

By

Dr. S.S.Ramaswamy*

Object:

1) Extent of prevalence of typical diseases/disorders ~~so~~ so as to focus attention on importance of control measures.

2. Correlate the incidence of such diseases/disorders with the concentration of pollutants, so as to arrive at the critical level to which control is to be effected(otherwise total control will be too costly).

3. To identify the preventive control measures needed.

Why Multi-disciplinary:

Diagnosis has to depend not only on clinical symptoms/ manifestations, but also on changes in metabolic functions, functions of systems such as respiratory, cardiovascular and CNS. Besides, at times the loss in performance capacity may also have to be evaluated. Simultaneously, the environmental concentrations (of pollutants) under which these changes occur, are also to be monitored, when we want to establish a cause-effect relationship. Hence, the disciplines industrial medicine, hygiene, physiology and psychology are all to work in a team.

Review of Current Literature

The health hazards associated with each industry/process is already known. A critical study of the current literature will enable one to know the bodily responses to be expected under such exposures, and also the sensitivity of the parameters. This will help in identifying the parameters to be studied in the particular project.

Familiarisation with the Experimental Techniques- Accuracy of the Techniques-

The technical assistants taking part in the study should first

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of all try all the sampling and analytical techniques to be used so that they can discharge their duties with confidence.

They should also evaluate the sensitivity as well as the fidelity of the measurements.

Environmental Sampling:

The sampling locations should be decided considering the hazards potential. Sampling frequency should be decided depending on the process. (Intermittent or continuous). The number of samples during the shift should be such that a time weighted average could be worked out. Sampling is, preferably, to be repeated on a number of days.

Sampling with personal samplers

When the symptoms are to be associated with the exposure, personal samplers are useful.

Biological sampling

Mostly urine and blood samples are taken.

Urine Samples- It is better if the collection in the blader during given time intervals is made (say for 1 hour, 2 hours etc.). Pre-exposure - Samples may be collected for 1 hour before the commencement of the shift. Postexposure samples may be collected during the 1 st 2 hours of the shift.

Normally grab samples are also taken. But these are only second best. In such cases connection for specific gravity of urine is to be made.

Blood samples: should be taken at the same time as urine samples.

Clinical Examination should be carefully done covering all the relevant systems.

Psychological tests:

Appropriate psychological tests such as memory tests, tests for neuromuscular coordination, steadiness tests, critical Flicker, Fusion tests are all to be carried depending on the exposure hazards.(Repeat observations are necessary)

Contd....

<u>...ological Tests</u>

Static and dynamic Pulmonary Function Tests are the commonly d physiological measurements. Sometimes detailed work capacity surements are also made.

<u>...blishing of norms</u>

If human beings are exactly similar to each other in their mal bodily functions and in the changes in them under stressful ations, then it is enough to study only a few subjects for the pose of establishing norms. But, unfortunately, even in such ple biological functions as heart rate, respiratory rate and y temperature, there is considerable variation from individual individual , since these functions are influenced by many factors h as age, sex, stature, nutritional status, state of physical training the environmental conditions in which they normally live. In w of this, in any endeavour to establish norms, the sample size is ided after taking into consideration the existance of these factors. instance, the pulmonary functions of a population of average ness will be affected by age, height and sex. If for establishing relation between age and physical fitness, it is necessary to dy at least 4 distinct age groups spread over a wide range and in h age group there should be at least 6 otherwise comparable ividuals, we need 24 subjects. Then we should have 4 height ups and 2 sex groups. Thus, the overall/total requirement will k out to be 6 x 4 x 4 x 2 = 192

<u>pointing the cause-effect relationship:</u>

The many changes in the normal physiological functions t may be observed in workers, need not be entirely due to occupational ses. For example in many industrial situations, the pulmonary ctions are impaired due to inhalation of some kinds of toxic dust chemical vapours. Due to exposure to chemicals like Benzene CS_2 the haemoglobin content of blood may be reduced.But similar airment can occur even due to natural causes like ageing, poor ritional status etc. Similarly hearing impairment results from

Contd....

exposure to noise and the eyesight is impaired due to exposure to abnormal lighting conditions, but such impairments can also be, to some extent, due to natural factors. The aim of the statistical design of any study is to eliminate the effect of these other influencing factors and pin point the effect due to the particular factor being studied. Even when all these other factors are thus controlled or accounted for, there is the possibility that the observed effect may be either due to random chances or may actually arise due to the factor under study. This can be decided by adopting appropriate statistical treatment.

Longitudinal and cross sectional studies:

By 'longitudinal studies' it is meant that the same group of subjects are studied before they work under the stressful situations and again after the situations are over. The advantage here is that the number of subjects can be minimal, since the subjects from their own controls and thus all other influencing factors are eliminated. In the cross sectional studies, we choose two otherwise comparable groups (i.e. matched for age, sex, socio-economic status and region), one of which is exposed to the hazards (experimental group) and the other is not (control group). In the Industrial situations, the effects are not always acute but are chronic and cumulative. Some effects may be noticeable only after a number of years. Hence, quite often, it is not possible to adopt the 'longitudinal techniques'. Only cross sectional studies are to be undertaken.

Statistical treatment of Data:

Mean and Standard Deviation

The difference in the responses among two groups of subjects or between two situations, can be judged from the mean values for the responses recorded, in respect of each group or situation. The 'mean' is the arithmetic average of values. But if there is a wide individual variation within the groups themselves, then the difference between the means (if meagre), will not reflect any significant change. Hence

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for comparison of the mean responses, it is necessary to work out the 'Standard Deviation' of the mean first. The Standard Deviation is the square root of the mean of squares of the differences between the individual values and the mean for the group of values.

$$S = \sqrt{\frac{(X - \bar{X})^2}{n}}$$

In a normal distribution, 95% of the values will fall between (Mean- 2 SD) and (Mean + 2 SD).

Normally, if a large randum sample (n) is selected for study, it can be taken that the mean value for such a sample will represent the mean for the entire population from which the sample is drawn. In such a case, if the standard deviation S is divided by $\sqrt{n}$ it gives the standard error SE which is a measure of the sampling variation.

Correlation Coefficient

When there is a cause-effect relationship, the extent of correlation between the two should be established. For instance, due to exposure to noise, hearing acuity is affected. If this is a general effect, then the percentage of people with noise induced deafness, should increase with the increase in noise levels. Or in other words, there should be a good positive correlation between the two.

The existence of a correlation can be ascertained by plotting the values on a graph paper.

The correlation coefficient:

$$r = \frac{(x - \bar{x})(y - \bar{y})}{(Sx)(Sy)}$$

or

$$r = \frac{n\ \Sigma xy - \Sigma x\ \Sigma y}{(n\ \Sigma x^2 - (\Sigma x)^2\ [n\ \Sigma y^2 - (\Sigma y)^2]}$$

Contd....

The correlation may be either positive or negative.

Significance of difference of means: ('t' test for small samples)

The improvement in the environmental conditions or in the physiological responses due to a control measure, can be considered to be there, only if the differences between the mean values for an environmental condition or the physiological response, before and after the implementation of the control measure, are significantly different. This can be verified by applying 't' test.

For this the differences between paired samples should be worked out. The next step will be to find out the Standard Deviation and Standard Error of these differences.

$$t = \frac{\text{Mean of the differences}}{\text{Standard error of the differences.}}$$

Then by referring to 't' tables, the probability of the differences arising due to random causes can be read. If the probabili[ty] is low, then the differences observed are really due to the control measures.

Tabulation of results:

The tabulation should be done in such a way as to elicit more information regarding each of the influencing factors. This is more so in respect of cross sectional studies.

Eg: Values of Pulmonary Functions in Foundry Workers

Age years	Exposure duration (yrs)			
	5	10	15	20
20 - 25				
26 - 30				
31 - 35				
36 - 40				

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INDUSTRIAL BURS & THEIR REHABILITATION

By
Dr. M. H. Keshwani M.S.*

Synopsis

The ability to control and use fire distinguishes man from all other animals. Since the use of fire, both in the home and in industry is so wide-spread, one would expect, and in fact there occur, many accidents. Many of these accidents could be avoided.

Data is not available on the total number of burns accidents in the country, In Bombay City, approximately 3000 burns patients are admitted in the large public hospitals. On an average, 500 - 600 persons die of burns each year in this city alone. The cost of treatment is enormous. But the total suffering caused and the lifelong deformities that remain, cannot be measured in monetary terms.

A survey carried out by us a few years ago, showed that approximately 74% of burns accidents occurred at home and only 26% at the place of work; 79% occurred in women and children; 93.5% were accidental 5.5% suicidal and 1.0% homicidal.

On the workplace burns, 34.5% were due to chemicals, 32.5% due to steam and hot liquids and only 14.2% were due to stoves, blolamps, etc. Impersonal factors predisposed to 62.2% of these accidents. Roughly one third of these were due to lack of safeguards, one fifth to defective equipment and one sixth were due to slippery floors and poor plant layout. Industrial burns occurred most commonly in the Metal & Steel, Pharmaceutical & Textile industries in this city.

Surprisingly, burns accidents occurred more often in units either with a work force of less than 50 workers or over 800 employees. Workers between the ages of 15 -35 years were most commonly affected. The workers skill of his length of service were not significant.

A brief review of the current methods of evaluating and treating burns will be made.

Recent trends in the research on burns will be presented.

Rehabilitation cannot be divorced from prevention of burns accidents. Both these aspects will be discussed.

PERSONNEL DECONTAMINATION

1.1 This write up is meant as a guide to the medical officers in the immediate management of persons contaminated with radioactive materials.

1.2 Decontamination is defined as "removal of undesired dispersed radioactive material from personnel, instruments, rooms, equipment etc." The physician will come into the picture only when personnel are to be decontaminated. In most cases the person will come to the physician after preliminary decontamination has been carried out by the Health Physicist. Occasionally the physician may have to see the patient without preliminary decontamination done by the Health Physicist, e.g., in life endangering emergencies.

2. <u>Procedures at accident site.</u>

2.1 If radioactive contamination is a problem, the physician should don a gown, overalls, shoecovers, respirator and use rubber gloves during the time of emergency first aid.

2.2 Major injuries such as arterial bleeding, broken bones or acute exposure to toxic gases, though occurring in a radioactive area, must be handled promptly and should have precedence over decontamination. [illegible] the life of the individual, precaution should be taken to minimise spread of contamination to first aid and medical facilities. Examples of this precautions are (a) administering first-aid at or near the scene of injury rather than at the first aid station. (b) removing potentially contaminated clothing and covering the victim with blanket.

2.4 Wash wounded area with large amount of water. Spread out edges so as to flush the wound well and relieve bleeding.

A light tourniquet may be applied to restrict venous flow without restricting arterial flow. These procedures are performed to limit the absorption of radioactive material from the wound.

Carry out other measures as the situation may demand.

3. Transport.

Contaminated patients may have to be transported by ambulance or other vehicles. Transportation vehicle should be protected by plastic sheets.

4. Decontamination Procedures.

4.1 Monitor the suspected area by suitable survey meters and record all readings. Call on the help of the health physicist for monitoring if necessary. Wipes from body surfaces on filter paper discs and on cotton tipped swabs from nares, ear canals, mouth and conjunctival surface should be taken and placed in separate labelled envelopes for future study.

4.2 Remove contaminated clothing carefully and deposit them in waste drums reserved for them, if not done already.

4.3 Monitor the individual from head to foot and determine the areas of highest contamination. Decontaminate the area of highest contamination first according to

procedure laid down below. If there is generalised contamination of the body with low levels of activity, a shower is recommended. Do not recommend a shower if there are spotty areas of high levels of contamination.

4.4 Wash thoroughly for 2-3 minutes by the clock using soap and plenty of tap water. Rinse completely and repeat procedure at least 3 times. If there is an associated wound which is not contaminated, cover it with sterile dressing before proceeding with skin decontamination taking extreme care to keep radioactivity from being washed into the wound. Do not use highly alkaline soaps or organic solvents. Give special emphasis to cleaning of finger nails, toe nails, nostrils, scalp, ear and body folds.

Monitor again.

4.5 If activity is still present, scrub parts with nail brush using soap and water for at least 5-10 minutes. Exert only light pressure on brush, do not press so hard that bristles are bent out of shape and see that skin is not abraded. This procedure should be repeated at least three times. Rinse off and discard brush and towels in waste drum.

Monitor again. If there is no decrease in the levels of radioactivity proceed with the subsequent steps.

4.6 Contamination of eyes, nose and mouth is best handled by irrigation with copious amounts of water or normal saline. Do not use eye cups. Radioactive material sticking to nasal or scalp hair can be removed by snipping these off

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by fine scissors. Save all used solutions in separate labelled bottles for future use.

4.7 If simple soap and water are not sufficient to remove contamination. Special materials can be used. These are 1% Citric acid solution, EDTA, Titanium dioxide for fission products and potassium permanganate for plutonium.

4.8 Save all samples of urine, stools, vomitus etc. if passed by the patient in separate labelled containers.

4.9 Give fresh non-contaminated clothing and reassurance to the patient.

5. Care of wounds.

5.1 Search carefully for small cuts and other breaches in the skin surface, since radionucleides can be absorbed by this route. Decontaminate such lesions by repeated 5 minute washings with cold water or normal saline. Warm water, complexing or chelating agents may enhance abrorption and generally should be avoided.

5.2 General surgical principles of asepsis, debridement of necrotic and severely damaged tissue, restoration of tissue continuity and treatment of shock and infection apply in these situations. Decontamination can be combined with asepsis by scrubbing the skin with detergents and more frequent washings with water. Sometimes shaving may rapidly remove the bulk of the contaminant. Care should be taken that contaminants on the skin are not carried into the wound.

5.3 After decontaminating the skin, irrigate the wound thoroughly with normal saline to remove any foreign material.

5.4 Necrotic and devitalised tissue must be removed removed surgically. All such tissue must be saved for analysis in suitable labelled containers. Extent of debridment will depend upon the level of activity, radionucleide present, its metabolism and toxic effects and the age of the patient. Use only the minimum essential instruments for surgical procedures. All linen, instruments and other materials used for a particular individual should be deposited in a separate container after use and marked "radioactive waste".

5.5 Penetrating wounds by splinters or slivers in the skin need to be removed promptly to prevent absorption of radioactive material in the body. When the radioactive contaminant is suspected to be either an alpha emitter like plutonium or a bone seeker the removal of such splinters should be as complete as possible.

6 <u>Special situations.</u>

6.1 For contamination with [illegible] products, Titanium dioxide may be used as a paste made by shaking the powder into the wet palm until a good paste is formed. Run tap water over hand continually to keep the paste wet and apply this lather to all surfaces, specially around the finger nails for a minimum of two minutes. Rinse off and wash with soap and

water and scrub with a brush. If any paste is left under nails after washing, it will form a rather hard cake which is difficult to remove.

6.2 For skin contamination with Plutonium, first try routine procedures. If activity persists, mix an equal volume of a saturated solution of Potassium permanganate (6.4 gm/100 ml.) with 1% H_2SO_4 solution and pour this weak acid solution over wet hands. Rub entire surface lightly with a hand brush. Use water and rinse off. Do not continue this procedure for more than two minutes. The skin will be stained a deep brown. To remove the stain use a freshly prepared 5% sodium acid sulphite solution in same way as above, using hand brush and water for two minutes. Do not use $KMnO_4$ for decontamination of the scalp.

This procedure can be repeated several times without appreciable harm to skin if each washing is limited to two minutes.

To wash face, neck, ears etc. the solutions may be applied with cotton.

If face or head is contaminated there is a probability of inhalation and/or ingestion of soluble or insoluble plutonium compounds. Eyes and nasal cavities or mouth should be irrigated with water or normal saline. If ingestion is suspected a mild saline cathartic (magnesium sulphate) may be given for 1-2 days.

6.3 Radium is hazardous because of the danger of retention of long lived alpha emitting nucleides in the body. If radium ingestion is suspected gastric lavage with 10% magnesium sulphate solution should be done as soon as possible. This may be followed by daily purging with magnesium sulphate to promote excretion of radium.

7 **Records.**

It is imperative that the following information is recorded in the patient's case record.

a. Name, Age, Sex, Division/Section.

b. How did the contamination take place.

c. Type of contamination (Alpha, Beta, Gamma, radionucleide, fission product etc.)

d. Level of contamination (Cps. or dpm)

e. Decontamination measure adopted.

f. Contamination levels if any after decontamination has been carried out.

g. Advice given to the patient.

It is necessary that the type and degree of contamination at each contaminated site on the body be noted separately [illegible].

8 **General Instructions.**

8.1 Patient showing fixed contamination of hands should be advised to eat food only with spoons etc. and not directly with the hands.

8.2 In order to make an estimate of the internally deposited radionucleide it is necessary to collect "on the spot" urine samples. [illegible] sample should be collected as early after the incident as possible and the

time of collection should be recorded. Subsequent cumulative samples should be collected every six hours until further instructions.

6.3 Take nasal swabs in every case, even if the contamination is limited to skin and even without an associated injury. If nasal swabs are positive for contamination, suspect internal deposition by inhalation. These cases will have to be investigated thoroughly.

6.4 Ascertain from the area health physicist relevant information including isotope identification. Contamination status at the site of incident, nature of the object causing injury and quantity of radioactivity present in the experiment.

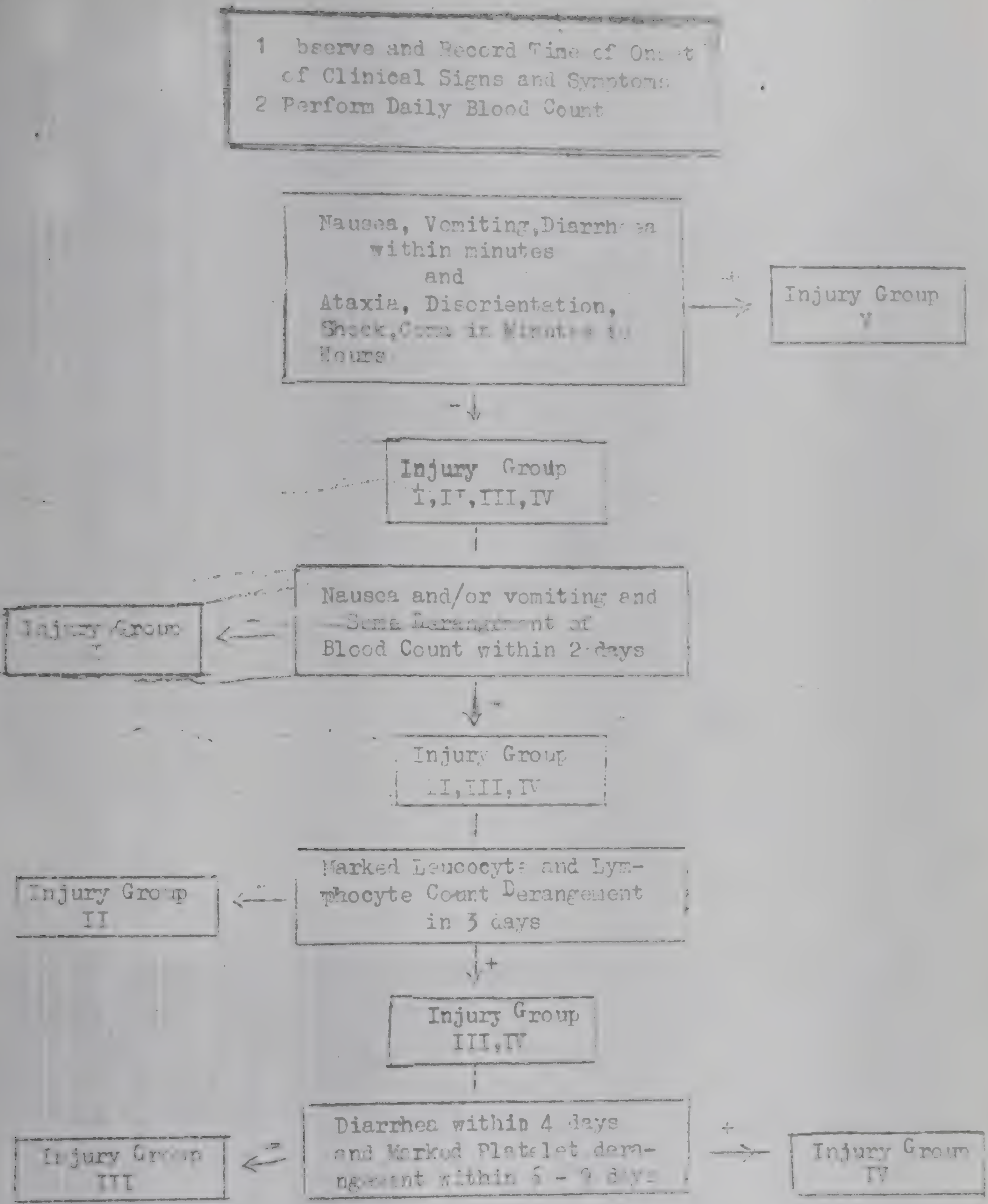
6.5 All patients who have been attended to at the dispensary for decontamination should be asked to return to the dispensary the following day for further evaluation and advice.

CLINICAL RADIATION INJURY GROUPS

Group No.	Clinical manifestations	Dose classification by -	
		Thoma & Wald*	Gerstner**
I	Mostly asymptomatic. Occasional minimal prodromal symptoms	[illegible]-160 rad----	51-100 r 101-150 r
II	Mild form of Acute Radiation Syndrome. Transient prodromal nausea and vomiting. Mild laboratory and clinical evidence of hema-topoietic derangement	200-400 rad----	150-400 r Hematopoietic
III	A serious course. Hematopoietic complications servere, and some evidence of gastroenteric damage present in upper portion of group.	400-600 rad ([illegible]97+).	401-600 r Hematopoietic
IV	An accelerated version of Acute Radiation Syndrome. Gastro-enteric complications dominate clinical picture. Severity of hematopoietic complications is related to survival time after exposure.	600-1400 rad--	Gastroin-testinal.
V	A fulminating course with marked central nervous system impairment.	10,000 rad ± 50 percent.	Cerebral

* Doses in rad according to approximate ranges of Table III of Thomas and Wald (1)

** Approximate doses in r from table III and section on Dependency of Acute Radiation Syndrome on Air Dose of Gerstner's (2). These doses are expressed as air dose, i.e., exposure dose, and are thus in terms of roentgens.



Preliminary Evaluation of Clinical Radiation Injury Following Overexposure.

INDUSTRIAL REVOLUTION AND HISTORY OF LABOUR LEGISLATION IN INDIA AND ABROAD.

DR. P. V. THACKER.

ustrial Revolution In England

"The steam engine drove the independent craftsman out of existence and industrial worker became the servant of the machine. After bitter resistance weaver descended from the dales and the cottage worker was forced to the tory. This was the era in which large fortunes were made, and mill owners, peting with each other to expand their markets and factories, did so on the is of who could sell the cheapest. No one thought they could afford fair es, especially as new machinery had to be paid for out of profits. The wages industrial workers were forced down and down and longer hours were worked. ger and hatred made Chartism a mass movement of the British working class. long as factory owners feared God, attended church or chapel on Sunday and morning prayers for their large families, their duty to their fellowmen finished". "In the early part of the Industrial Revolution children, male female, aged 7 to 14 years, were compelled to work in the mills of Yorkshire Lancashire from six in the morning to 7 in the evening with only 30 minutes eating and recreation. Children aged 5 and 6 years were employed underground mines to work the ventilation doors, spending as long as 12 hours in solitude.

The first legislation to improve the lot of the factory worker was sed under Robert Peel's guidance in 1802. The "Health and Morals of rentices' Act" as it was known then, shortened the working hours, prohibited ht work for children, required factories to be white washed and ventilated empowered Magistrates to inspect the factories. However, it was not until 3 that some progress was made when four factory inspectors were appointed. Factories' Act 1844 was a compromise which arouse out of intense agitation the workers "for 10 hours" Bill. It was applicable only to women and ldren. Thanks to the crusade carried out by social workers and men of erature against the inhuman treatment and exploitation of the industrial kers that subsequent years witnessed appointment of a number of Royal missions and ushering in further legislation for labour welfare. The sting Factories Act in England was passed in 1937.

ian Scene

British factory owners who were looking for cheap labour soon ended their activities to India, and the Industrial Revolution gradually spread all its ill effects on the weaker section of the society. In fact, the

The need for adding welfare amenities to contractual relationship between employer and the workers had to follow the same pattern as in England and the State had to intervene using its persuasive powers and/or by enforcing legislation.

The first Indian Factories' Act was passed in 1881, but there was no provision under this Act or even its subsequent amendment in 1891 requiring the appointment of Inspectors to enforce the provisions of the Act. District Magistrates and Civil Servants were ex-officio Inspectors. The Factory Labour Commission 1907 severely criticised this system of inspection by District Magistrates who had neither the time nor the knowledge for the job. It was only in 1911 that a special provision was made for the appointment of Factory Inspectors.

The existing Factories' Act 1948 is an aftermath of a number of commissions and committees appointed prior to 1948, important amongst which were Whitley Commission 1928, Bhor Committee 1946 and Rege Committee 1944. The Whitley Commission, in taking note of the varying conditions in different establishments recommended that the more indifferent employers might be brought at least upto general level which was much below what was provided by progressive employers, favoured consolidation and extension of the principle already recognised in the Factories' Act in the clause dealing with the general health, safety and welfare of the operatives. It did not desire to overload the Act, but sought a method which Governments could secure a uniform minimum standard of welfare where the nature of the processes carried on or the special conditions and circumstances of employment demanded it.

The Rege Committee, while recognising that some aspects of welfare had been receiving attention in individual centres/establishments mainly from local associations of employers, referred to the effect of welfare measures on the general atmosphere in the factory and their contribution to the maintenance of industrial peace. It recognised the role both of the employer and of the government in this regard and listed a number of facilities which, if provided, were likely to promote a feeling amongst the workers that they had a stake in the industry as much as anyone else and reduce labour turnover and absenteeism and stabilise an economically efficient working force.

Legislation

Given below are important Labour Legislations and their role in respect of Industrial Health and Safety :-

The Factories' Act, 1948 and the rules framed thereunder govern the undertakings which are engaged in "manufacture" and "manufacturing process" a

r its various chapters, the Act lays down provision in respect of Health, ty, Welfare, working hours, employment of young persons and women etc. Under ter III, the Act recommends measures for maintaining cleanliness in the factory, sal of wastes and effluents, control of dusts and fumes, maintenance of proper lation and temperature, lighting, provision of drinking water, facilities for nes, urinals, spitoons etc. Chapter IV of this enactment is entirely devoted to y measures which include fencing of machinery, employment of young persons, fic provisions pertaining to dangerous machinery, explosive materials, fires, and ntment of a Safety Officer in factories employing more than 1000 workers. It down an express ban on employment of women and children in dangerous units of actory. Statutory Welfare measures include provisions of washing facilities, aid appliances, canteens, rest rooms and lunch rooms, creche etc.

The Employment of Children Act, 1938 regulates the employment of children rtain specific industrial employments and the children (Pledging of Labour) 933, prohibits the labour of children below 15 years of age in transport try and ports as they are and have been grossly exposed to exploitation in the of unscrupulous employers in matters of safety.

The Maternity Benefit Act 1961 regulates the employment of women in certain lishments for certain establishments for certain periods before and after birth and provides for maternity and other benefits, as stipulated in this ent.

The Workmen's Compensation Act 1923 regulates payment of compensation to s in respect of industrial injuries and occupational diseases suffered by them. the Employees' State Insurance Scheme (E.S.I.S.) is in force, this sation amount is disbursed by the Employees' State Insurance Corporation. In not covered under the Scheme, the compensation amount is payable by the employer.

Employees' State Insurance Act 1948 is a social security regulation which es 5 main types of benefits viz. sickness benefit, disablement benefit, ity benefit, medical benefit and dependant's benefit. Under this Act, rs and workers are expected to make contributions specified under the Act. e funds thus collected the E.S.I. Corporation undertakes disbursement of ve benefits.

OCCUPATIONAL LUNG DISEASES

By
Dr J.C. Kothari

Introduction:

It is a group of diseases that affect the lung as a result of inhalation of dusts, gases, fumes or infectious agents at the work site or in the environment as a whole. Hence, it may broadly speaking, be proper to define them as environmental lung diseases.

Physicians practicing in areas, where such occupational hazards exhist, are usually prompt in detecting these cases. In non-industrial areas, physicians are not well aware of these problems and many cases with history of occupational exposure in the past may not be recognised. Gaensler (1) has reported an incidence of 5.8% primary occupational pulmonary disease.

Historical:

In the middle of the 16th century, Agricola (2) gave a detailed account of the working conditions in mines in a treatise "De Re Metallica". He noted that miners had a shorter life due to lung disease. He makes the following observation. " In the mines of the Carpathian mountains, women were found who have married seven husbands, all of whom this terrible consumption has carried off to a premature death". He advocated preventive measures by adequate ventilation and use of loose veils over the face. In England Charles Thackrah in the 19th century surveyed the health hazards in various industries then existing in the country.

History:

A thorough history of the patients present occupation his work environment, details of raw materials and products handled by him are very important. Of equal importance is a history of all his past occupations. Very often, the present illness may be a result of exposure to material handled in a previous occupation several years ago. As a rule it takes several years of exposure to a toxic substance before the disease manifests itself. Besides this, the bronchial clearing mechanism enzyme deficiencies and hypersensitivity can influence the occurrence of lung lesions.

Classification:

There is an infinite variety of substances that can cause occupational lung disorders. Many of the disorders are non-specific in nature and are diagnosed by history of occupational exposure, symptoms or pulmonary manifestations. The following is a broad classification suggested by Fitzgerald, Carrington and Gaensler (3)

Inorganic Dusts:

1. Free Silica:
   a. Crystalline - quartz, trydymite, cristobalite
   b. Amorphous - diatomaceous earth, silica gel.

2. Silicates:
   a. Fibrous - asbestos, sillimanite, talc, sericite
   2. Other - mica, Fuller's earth, kaolin, cement dust.

3. Carbon:
   Coal, graphite, carbon black, soot, charcoal.

4. "Inert" metals:
   iron, barium, tin.

Biological Dust

1. Vegetable: Moldy hay (Farmer's lung), mushroom, compost, bagasse, maple bark, B. subtilis enzyme (detergents), malt, grain-weevil, cork, roof-tatch, lycopodium.

Animal:

Pigeons, parrots, budgerigars, hens, pituitary snuff.

Toxic Chemicals:

1. Irritant gases:
   Oxides of nitrogen, sulfur-dioxide, ammonia, chlorine, ozone, phosgene, carbon tetrachloride, hydrogen chloride, etc.

2. Metallic fumes:
   vapours, oxides and salts: beryllium, silicides, mercury cadmium, platinum, manganese, zinc, vanadium protoxide. nickel, osmium.

3. Plastics: Ploytetrafluroethylene, toleune diisocyanide (TDI)

4. Aerosols: mineral oils, 'cutting' oils, $CuSO_4$

Occupational Respiratory Infections

1. Bacteria: Tuberculosis (miners, nurses, pathologists), anthrax, glanders.

2. Virus/rickettsial: Psittacosis.

3. Fungi: Coccidiomyocosis (irrigation, farm work, archeology) histoplasmosis (poultry, pigeons) cryptococcosis (pigeons)

Occupational Respiratory Carcinogens: Arsenic, cobalt, nickel, haem, uranium, chromates, asbestos, tar, etc.

SILICOSIS

It is probable that Silicosis existed in pre historic times.
Hippocrates observed "the difficult breathing of miners".

It occures in workers engaged in the following occupations/ industries.

> Ceramics, potteries, granite, sandstone, flint, abrasives, gold mines, tin, copper, silver, zinc, iron ore, coal, graphite, metal grinding, iron and steel foundries, sand-blasting, tunneling, Glass manufacture. The causative factories are:
>
> 1) particles size of the dust
> 2) duration of exposure
> 3) concentration of dust in air

1) Any dust particles 710 micron in size are filtered out in the nose and upper naso-respiratory passages and removed by the ciliary action of the bronchial lining. There is no ciliary epithelum in the alveoli. Here the phagocytes come into play. Dust particles less than 5 microns in size are deposited in the terminal bronchioles and alveoli. The optimum size for retention is 1 micron. Continuous and prolonged exposures leads to breakdown of the natural defence mechanism and eventually nodular fibrosis develops.

2) An exposure period of 2 to 10 years is necessary to produce disease. Often, the disease may appear long after exposure has ceased and the patient has changed to a different occupation. Individual immunological mechanism may also play an important role. Therefore a small minority of workers may not get the disease even after many years of heavy exposure. Occasional the disease may appear after a short exposure and in epidemic form.

3) Concentration of silica dust greater than 5 ppm per c.ft. of air are highly injurious.

Pathogenesis:

It is the silicon dioxide (Sio2) which is capable of producing fibrosis. Silicates are not able to produce the lesion. There are several theories of the mechanisms of causation: Mechanical, chemical and immunological.

T lymphocytes – Delayed hypersensitivity Reaction [illegible]

Pathology:

The characteristic lesions are numerous Silicotic nodules 2 to 5 mm in size. The severe forms of the disease, several nodules form large massive nodules by coalescence – the massive fibrosis. Histologically the silicotic nodule is seen as whorls of concentrically laminated fibrous tissue. Cavitation occurs due to ischemic necrosis or supervening tuberculous infection.

Incidence:

In India, several surveys have been carried out by the Ministry of Labour, to determine the incidence of Silicosis. The potteries and ceramic industry, it was found that 15.7% had X-ray evidence of Silicosis (4). In coal mines in Bihar, 18.8% incidence has been reported (5). In mica mines, 34.1% incidence has been reported (6).

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Clinical picture:

There may not be any symptoms for many years. However, a chest radiograph may show abnormality long before symptoms devenop. Shortness of breath, cough with expectation may be the first symptoms. They are progressive unless the person is removed from further exposure. If exposure continues, complications eventually develop. They are pulmonary tuberculosis, pneumonia and corpulmonale. Physical signs are not specific. There are signs of emphysema. More than 20% of silicosis patients eventually develop pulmonary tuberculosis.

Diagnosis:

In general there are no specific diagnostic signs in occupational lung disorders. The following broad guidelines are applicable to the whole group of disorders. References will be made in appropriate disease conditions to specific criteria.

General Diagnostic Criteria:

A thorough history of occupational exposure should be obtained. This has been discussed earlier.

Chest Roentgenogram: Almost always shows evidence of fibrosis and specific characteristic lesion of individual toxic agents.

Lung Biopsy: for the purpose of differentiating obscure conditions from occupational diseases.

Physical signs: are not specific. Rales may be present, Clubbing, cyanosis signify complications like Cor Pulmonale. There may be extra pulmonary manifestations E.G. Ascitis in asbestosis, extrapyramidal signs in manganese toxicity, and multisystem involment in beryllicsis.

Pulmonary function:

1) They are of no diagnostic value to detect specific disorder.
2) They serve to quantitate the severity of mulfuction and to follow the course of the disease, using the patient as his own control.
3) Corrlection of lung function with radiological abnormalities is poor. Severe functional disturbances may be found in patients with normal radiograms. Reverse situations are not uncommon. Therefore chest X-ray alone should not be used for disability evaluation.
4) Obstructive syndrones generally lead to dyspnoea. Dyspnoea generally corrletes well with objectively measured lung function.
5) In certain entities e.g. asbestosis, beryllicsis, there is impairment of gas exchange. The arterial O_2 tension, A-a gradient and diffusing capacity are abnormal. They however, correlate poorly dyspnoea.

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6) Impairment of lung function is not synonymous with disability. Disability occurs when the worker's performance is less than that of a group of normal individuals of the same age, sex and stature. Quite often, function may be markedly reduced without significant impairment of function a worker may be severely disabled because of cough, generalised toxicity or recurring respiratory infections.

Radiological Classification- Terminology

The ILO Classification has recently been expanded and more precise terminology has been included in the UICC/Clinical Classification (illustration of Radiograms).

Associated disease and complications:

Routine tuberculin testing of all individuals at risk should be done. A reaction more than 10 mm to .001 mg. PPD indicates infection with tubercle bacilli. The chest X-ray may not show evidence in early stages. Those persons should receive prophylactic INH therapy for one year. Conglomerate shadows on X-rays and positive sputum culture establish diagnosis. Cavities on X-rays may also be due to ischaemic necrosis without tuberculosis infection.

Treatment :

There is no effective therapy for Silicosis. Inhalation of aluminium dust has been advocated to retard fibrosis. Recently Schlipkoher (7) has shown that Polyvinylpyridine -N-oxide(PVNO) is effective in animals to diminish fibrosis. This study has not yet been confirmedby other workers.

Therefore the main treatment consists in prevention, Proper dust control measures, environmental hygiene, protective masks and industrial engineering can go a long way in controlling this disease. respiratory infections, bacterial or viral must be promptly treated. Smoking should be discouraged.

I shall now briefly discuss other occupational lung disorders

Coal Workers Pneumoconiosis(CWP)

Exposure to coal dust particles more than 5 microns can cause CWP. In the sample form of the diseases, the X-ray shows a fine reticular pattern. In the complicated form the X-ray shows nodularity progressing to massive fibrosis. This is usually due to secondary infection especially with mycobacterim. Caplan described the association of rheumatoid arthritis and progressive massive fibrosis. This is thought to response. In the terminal stage, mortality is due to fibrosis, Cor Pulmonale and tuberculosis.

Asbestosis

More than 2000 years ago, the Romans and Egyptians were known to use asbestos textiles for cremation attire.

Asbestos is used as insulating material in electrical wiring heat insulation, brake lining, heat resistant textiles, fire proofing etc. Asbestos fibres 20-30 microns in length, when inhaled lodge in respiratory bronchioles. The characteristic pathological feature is the asbestos bodywhich may be found in sputum. It resembles a drumstick. It appears as brown or black fibres upto 75 microns in length. The patient presents with a history of cough and dyspnoea.

In advanced cases there may be clubbing and cyanosis. X-ray shows diffuse fibrosis, with pleural thickening and calcification, more at the basis. Pleural effusions may also occur. Asbestos is carcinogenic. Mesothelima and bronchogenic carcinoma occur more frequently in asbestos workers. Peritoneal mesotheliomas and ascitis also occur.

Lung function studies are characterised by impaired gas exchange and alveolar capillary block. Treatment is symptomatic.

Beryllium Disease:

Several years ago the commonest exposure to beryllium occured in flourescent light industry. Now the use of beryllium in this industry has been discontinued. Exposure can occur during its extraction from ore. Industrial uses of beryllium include making Beryllium copper alloys and solid fuel rockets. Particles larger than 10 microns in size are injurious. It is characterised by low incidence in exposed workers and long latent interval. It can manifest in acute or chronic form. The acute form is characterised by fever, dyspnoea, cough and weight loss. X-ray shows patchy pneumonitis. Recovery occurs in 1-4 months. In the chronic variety, the disease develops insidiously. After a latent period of weeks to several years. The symptoms are chronic cough, dyspnoea and weight loss. Chest X-ray shows fine miliary modulation with diffuse fibrosis. The characteristic lesion is a granuloma resembling Sarcoidosis. The liver, spleen kidney heart and skeletal muscles may be involved. At times diagnosis from Sarcoidosis is difficult.

Treatment: Steroids have been found beneficial.

Biological Dusts:

Byssinosis:

It is a chronic lung disease occuring in textile workers engaged in carding and spinning room as a result of inhalation of cotton dust. The cotton dust is a complex mixture of cotton fibres and fungi. In the early stages of exposure the worker experiences only a slight cough and tightness in the chest which may be regarded as bronchitis. Following a weekend without exposure, these symptoms develop on a Monday on return to work. This may be accompanied by fever - "Monday morning fever". After several years, these symptoms become chronic and are present throughout the week. Dyspnoea and asthma may be progressive. The physical findings are those of chronic bronchitis and emphysema.

Incidence:

In USA, 25% of carders and 12% of spinners have airway obstruction, indicating that upto 17,000 textile workers may be affected (6). In UK it is 63% in West Germany 62% and 27% in Egypt. In India several studies in the textile centres like Bombay, Ahmedabad, Kanpur and Madras. were carried out by using the questionnaire method recommended by Schilling. From these studies it is apparent that the incidence in our country is lower than in the West. It varies from

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3-8% to 8.4% in various centres. No plausible explanation is available.

Causation: It is likely that Byssinosis may be due to an allergic response of the bronchial mucosa to one or more unidentified allergens in the cotton dust. A positive skin test to extracts of cotton dust is found only in a small porportion of workers. It is also found positive in co-workers of patients who have no symptoms and also in persons who have never worked in textile mills. Recently it has been shown that the disease correlates more closely with enzyme levels in the dust than with dust levels themselves.

Diagnosis: The diagnosis mainly rests on a history of occupational exposure and the characteristic symptoms. X-ray picture may be normal in early stages and in later stages may show non-specific changes of bronchitis and emphysema. The FEV tested before the work shift and the end shows a significant drop. For survey work a combination of questionnaire method of Schilling (10) and Timed Vital Capacity tests are employed. Schilling has stressed the importance of pre-employment and periodic examination of textile workers. People with pre-existing lung disease must not be recruited and those with progressive impairment of lung function must be removed from further dust exposure.

Farmer's Lung: It is a disorder of agricultural workers who store hay in moist conditions whereby the hay becomes moldy. Recently a thermophilic actinomycete has been identified as the causative agent. Campbell in England and Towey in USA (11) first reported several cases of Farmer's lung. The illness may be acute or insidious in onset. In the acute form, it is characterised by chills, fever, cough and dyspnoea occuring within a few hours of exposure to moldy farm dust. Occasional dyspnoea may predominate the clinical picture and fever may be absent. The symptoms disappear on cessation of exposure and repeat on further exposure. Repeated exposure may lead to insidious chronic illness resulting in progressive pulmonary insufficiency. It has been estimated that a farmer working with a moderately dusty hay retains 750,000 spores per minute in his lungs.

Chest X-ray shows a fine granular pattern, linear striation and patchy areas of conglomerate densities.

Pulmonary function studies reveal, reduced diffusing capacity, uneven distribution of ventilation and perfusion, but no significant airway obstruction.

Lung biopsy shows granulamatous interstitial pneumonitis. It is thought that the disease is due to an acquired hypersensitivity to molds or fungi. The sera of farmers exposed to moldy hay have shown specific antibodies.

Treatment Treatment of acute episodes is symptomatic. Steroids are helpful. Further exposure should be prevented otherwise crippling pulmonary disease may develop.

Silo Filler's Disease:

It is also a disease of agricultural workers engaged in silos. In poorly ventilated or closed silos, nitrogen oxide is generated which on inhalation leads to acture chemical pneumonitis. In severe exposure, there may be pulmonary oedema and death. It is important to remember that only a recently filled silo may be the cause of disease.

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Bagassosis:

It is a disease of sugar cane workers arising from expos to fibrous residue to sugar cane after sugar has been extracted. It leads to fever cough and dyspnoea. Most workers recover spontaneou but a few may progress to pulmonary fibrosis and insufficiency.

Fumes and Gases:

There is a variety a fumes and gases which can cause chem pneumonitis e.g. SO2 NO2, Kadmium Oxide etc. Besides, gases and fu there is a miscellaneous group of compounds which can produce sensit tion e.g. Toluene Diisocyanate (TDI) and proteolytic enzymes used in detergent industry.

There is also a greater risk of lung cancer in uranium workers, niclo and chromate workers and asbestos industry.

Conclusion:

A variety of well recognised occupational lung disorders receiving attention of industrial physicians. The list is ever inc ing. A few important entities have been discussed. The significan of a thorough history as an important tool in diagnosis is emphasis Prevention lies mainly in a proper environmental hygiene. It may be pointed out that certain synergistic factors may aggravate the cour or indirectly contribute to the causation of industrial lung disea There are:

Tobacco, Alpha-1, Antrypsin deficiency, Infection, Allergy and Bronchitis (12).

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PRE-EMPLOYMENT MEDICAL EXAMINATION - SOME SPECIAL TESTS

Dr. S. S.Ramaswamy

Under Model Rule No.116 framed under Section 87 of the Factories Act 1948, there are a number of processes for which pre-employment and periodical medical examinations have been stipulated. Besides these processes, there are others which also involve exposure of workers to toxic substances which will result in a progressive deterioration in their health status. In many of these cases some particular organs or systems in the body are affected depending on the toxicity of the substance absorbed. A general medical or clinical examination, whereas important, will not alone reveal the quantitative effects of these toxic substances on these various organs. Hence in any occupational health study it is essential that many special tests viz. biochemical investigations, pulmonary function tests, psychological tests, etc. are also included besides the routine clinical examination.

Unfortunately, when such measurements are made randomly at any point of time after the worker has been employed in the concerned process for some years, the question arises as to whether the effects observed are entirely due to the current working environment in the particular plant or processes, or they also reflect some remnant effects from the previous employment or exposure. This difficulty can be easily overcome if the same tests are included in the pre-employment and periodical medical examinations irrespective of whether such tests are carried out voluntarily, or with a view to fulfill statutory requirements. Of course, in many cases the results of such investigations may be negative. Even then they will serve as valid base data. Such base data will be effective in establishing the occupational nature of the affliction observed.

Details of the hazardous processes covered under various schedules under Model Rule 116 framed under Section 87, for which pre-employment and periodical medical examinations have been stipulated

No	Process	Major toxic substances to which workers are exposed	TLV mg/M^3	Medical Examination Pre-employment	Periodical
	(2)	(3)	(4)	(5)	(6)
	Electrolytic plating or oxidation of metal articles by use of electrolyte containing chromic acid or other chromium compounds	Chromium(Hexavalent)	0.50	30 days	3 months
	Manufacture and repair of electric accumulators	Lead dust and fumes	0.15	7 days	1 month
	Glass Manufacture	1. Lead 2. Hydrofluoric acid(HF)	0.15 2.0	7 days	1 month
	Manufacture and treatment of lead and certain compounds of lead	Lead dust and fumes	0.15	14 days	3 months
	Printing presses and type foundries and certain lead processes carried therein	Lead fumes	0.15	14 days	3 months
	Manufacture of pottery	Dust containing free silica	-	7 days	3 months
	Chemical works - manufacturing, processing, formulation or use of - Hexaethyl tetraphosphate Tetraethyl pyrophosphate Parathion, Nicotine & Nicotine Sulphate Mercury derivatives Methyl bromide Cyanides, Arsenical derivatives, Chrome Process compounds	Organic phosphorus compounds which affect certain enzyme systems Nicotine which depresses the CNS Mercury Compounds(Mercury) EEG changes Toxic cyanides Arsenic Chromium	0.01	14 days	3 months

(1)	(2)	(3)	(4)	(5)	(6)
XVIII	Handling and processing of Asbestos, manufacturing of any article of Asbestos and any other process of manufactures or otherwise in which Asbestos is used any form	Asbestos Fibre	-	3 months	3 years
XIX	Manufacture manipulation of Manganese and its compounds	Manganese	5.0	14 days	3 months
XX	Manufacture or manipulation of dangerous pesticides	Mainly organo phosphorus compounds	-	7 days	6 months
XXI	Manufacture, handling and usage of Benzene and substances containing Benzene	Benzene	0.5	Immediately	6 months
XXIII	Manufacture or manipulation of carcinogenic dye intermediates	Carcinogenic amino Compounds	-	14 days	6 months

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medical examination is prescribed under Model Rule 116, but may be voluntarily carried out by the plant Medical Officers

Schedule	Process	Major toxic substances to which workers are exposed	TLV mg/M3
V	Grinding or glazing of metals and processes incidental therto	Dust containing free silica	depending on free silica content
VII	Generating petrol gas from petrol	-	-
VIII	Clearing or smoothing roughening,etc. of articles by a jet of sand, metal shot or grit or other abrasive propelled by a blast of compressed air or steel	Dust containing free silica (in those sections where sand blasting is permitted)	-
IX	Liming and Tanning of raw hides and skins and processes incidental thereto	Hexavalent Chromium where chrome tanning is done	0.5
	Viscose Rayon	Carbon Disulphide	60
		Hydrogen Sulphide	15
	Fertilizer	Phosphorus	0.1

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Table-3 Some important diagnostic tests (special tests) for the chronic effects of important toxic substances, which should also be included in the pre-employment and periodical medical examination

Toxic substances	Diagnostic tests: Biochemical	Clinical	Physical/pulmonary function	Psychological
(1)	(2)	(3)	(4)	(5)
Asbestos Fibre			Vital Capacity, FEV_1 Dyspnoeic Index	
Benzene	Phenol in urine, Haemotological tests			CNS tests
Carbon Disulphide	1. Estimation of exposure coefficient (iodine azide test on urine) 2. Cholesterol	ECG		CNS tests
Carbon Monoxide	Carboxy Haemoglobin Haemoglobin	ECG ?		
Carbon Tetra-	Liver function, SGOT (Serum glutanic oxalo-acetic transaminase)			CNS tests
Chromium	Chromium in urine	Nasal septum examination	Pulmonary functions, Dyspnoeic index	
Hydrogen Sulphide		Bronchitis, ECG ?		
Lead	1. Urinary lead (early morning sample-mass excreted in given time) 2. ALA in urine 3. Haemoglobin 4. Stippling of cells	B.P. ?		1. Steadiness test
Manganese	1. Manganese in urine 2. (early morning sample-mass excreted in given time) 2. Serum Calcium 3. Serum [illegible]			1. Steadiness test 2. Neuromuscular coordination

(1)	(2)	(3)	(4)	(5)
...ry	1. Mercury in urine(early morning sample,etc.) 2. Haemoglobin ? 3. Liver function tests			1.Steadiness test 2.Memory tests
...ine	Nicotine in urine (Morning samples)	Muscle weakness	Pulmonary functions?	CNS tests
... and Nitro... ...nds	1.Methemoglobin 2.Para nitro phenol in urine 3.Hemato porphyrins in urine 4.Haemoglobin		Pulmonary functions?	CNS Tests?
... phospho- ...pounds ...hion, Mala- ... etc.)	Cholinesterase activity of plasma and RBC	Abdominal complaints		Memory tests Steadiness tests?
...	1. Phenol in urine 2. Hydroquinone in urine		Pulmonary functions Dyspnoeic index	1.Steadiness tests 2.CNS tests
...horus ...)	1. Aminoacids in urine 2. Haemoglobin	ECG ? ECG ? Denture		
... dust		Chest X-ray	FVC, FEV_1	
...	1. Hippuric acid in urine 2. Benzoic acid in urine			

<u>Physical Hazard</u>	<u>Diagnostic Tests</u>
Noise	Audiometry

MANUAL WORK IN ADVERSE CLIMATIC CONDITIONS.

By

Dr. S. K. Sensarma*

To find out the overall stress and strain of any work in any industrial work situation, it is imperative to assess both the thermal stress and workstress involved in it, and once these are evaluated, certain ameliorative measures could be suggested as and when needed.

Coal mining is an ideal example of adverse climatic conditions, which provides a unique work situation. Coal mines are mostly shallow, the temperature increasing with increased depth, due to geothermic gradient. Mining condition is usually hot and humid, having little difference between dry and wet bulb temperature, perhaps due to shallow working and seepage of large quantity of subsoil water. The ventilation is poor in the working sites, making the environment sluggish. The hothumid condition and the still air make the condition quite stressful.

Coal mining in India is still a semi-mechanised industry, the mechanisation being restricted to the 'coal cutting machine', 'electric drill' and, blasting of coal with permitted explosives, and consequently labour intensive. The age old method of getting coal by means of a handpick and manual filling and carrying the coal baskets are still in vogue. Mining operation practised still to-day are pick mining, shovelling, load carrying, drilling machine operating and pushing the empty and loaded coal tubs, besides some ancillary work. In some operations, the work is light or moderate, while in others the work spells are short but strenuous.

In view of the adverse mining condition the prevailing operations are found to be more taxing to the workers in comparison to the actual work intensity. Thermal impact of any work is dependant on three factors in any industrial work situation, if the overall situation is to be assessed-

a) Activity level of the task to be performed
b) Thermal load of the work sites
c) Duration of performance.

Effect on Sustained Work:

Three typical mining operations namely pick mining, shovelling and machine driving were studied on three groups of coal miners such as pick miners, loaders and machine drivers. They were all accustomed to the type of the work performed and well acclimatised to the mining condition, since the time they have adapted mining as their career. The pick miners get the coal by a hand pick for 15 - 30 minutes at a stretch depending on the thermal condition and condition of the coal strata while the shovellers fill the cane baskets when the coal is available after machine-cut by the machine operators. For one cut the machine drivers usually take 30-45 minutes right from the movement of the

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machine to the working faces and getting back to the safe place near gallary face. The loaders shovel the coal to fill the basket - for filling the tubs by their counterparts - fill the available coal is exhausted, sometimes from 45 minutes to 1 hr.

Table 1, 2 & 3 show the findings when the operations are performed under different thermal districts of the mine. The tables show that pickmining is of arduous nature while the shovelling and machine driving are moderate, from the work stress point of view. It is seen that the same work when performed under varied thermal conditions, produces varying strain on the workers. The higher the thermal load, the higher would be the impact, indicating greater strain imposed, although the work intensity and pattern of work remain unaltered.

The working pulse for the work like shovelling and machine driving involving even less muscular exertion are found to become tiring under adverse condition, while the pickmining when performed under less adverse climate, the peak heart rate exceeds the limit for sustained work (within 130 beats/min.). But the working pulse for the operation become dangerously high under adverse work situation. This is due to the combined effect of both the work load and thermal load to produce undue strain as manifested by abnormally high cardiovascular reactions and heat storage values.

The oral temperature data show that the body temperature remain practically normal in most cases when performed under less adverse situation but heat storage is found when this limit is exceeded. It is, thus, evident that work under adverse thermal condition is deterimental to the workers and thereby the work under situation needs rest pauses in between the work cycle as otherwise miners will continue to accumulate fatigue.

Recovery heart rate - Brouha (1967) recommended that for normal recovery, the 3rd minute recovery pulse rate should remain always below 90 beats per min. and if it remains above this level, the recovery should be considered unsatisfactory.

According to this criteria, it was observed that recovery patterns for shovelling and machine driving are satisfactory under less adverse condition, but for pickmining even under this condition the 3rd minute recovery heart rate remains above the allowable limit. This indicates that the work load remaining within 50% of VO2 max. under less severe condition exerts strain within acceptable limit, but for pickmining, recovery pattern remains unsatisfactory even under comparatively cooler environment which must be due to higher intensity of work involved in the work of pickmining. These finding illustrate that adverse climatic condition transform an easy task into a harder one demanding proper reorganisation and rationalisation of the work and working situation.

Repetative work

Brouha (1967) has shown that while the energy cost of a work is practically independent of the environmental heat stress, the cardiovascular response is very much dependent on the latter.

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INDUSTRIAL HYGIENE

Dr. P. V. THACKER

WORKING ENVIRONMENTS - THEIR EFFECT ON JOB PERFORMANCE

SOCIAL FACTORS: India is still largely an agricultural country. It is almost impossible to support our large population on agriculture alone which also is subject to the vagaries of monsoon. In order to raise the standard of living of the common man, industrialisation is inevitable and we have embarked on this process through the lead given by our first Prime Minister Pandit Nehru. The first and successive 5-Year Plans have allocated more and more funds for setting up industries both in the private and public sector. This has lead to migration of rural population to industrial towns and estates with consequent overcrowding and imbalances both physical and mental which are reflected in the form of industrial unrest and rise in mental disorders.

A large majority of our industrial workers are migrants from rural areas. For them life in industrial slums and being away from the family is a matter of great change. They have to travel long distances in crowded city transport services. Working on big and fast moving machines producing heat, humidity, dust, noise etc. is totally different from what they have been used to so far on the farms. This change in the mode of living and in the type of work calls for a reshuffle of the workers' adaptive forces. The routine of factory life and work in shifts at odd hours of day or night with disturbed rhythm of sleep is something to which they have not been used to so far. It may affect their peace of mind and even produce adverse psychological reactions. Working with people belonging to different castes, creed and religion and with persons whom they have never met before has an impact on the mind of the workers. It may affect their job performance if they are not happily placed. An individual worker may not like some of his co-workers and their methods until he is adjusted to the new surroundings and many a worker is known to have broken down during this period of adjustment.

INDUSTRIAL REVOLUTION:

Invention of steam engine in provided availability of power to work the Machines, which gradually replaced independent craftsmen. Today, an industrial worker is subservient to Machine. Anything produced by hand has become costly and out of reach. Colonial Powers, particularly England, realised that with use of Machines, they could produce cloth at a much cheaper rate than what a traditional Indian worker was doing them. They had a ready market in India and in fact the industrial revolution in England started with Textile Industry. It was an era in which large fortunes were made and Millowners competing with each other to expand their markets and factories, did so on the basis of who

workers were forced down and down and longer hours were worked. Children, male and female, between 7 and 14 years were compelled to work in Mills of Yorkshire and Lancashire from six in the morning to seven in the evening with only 30 minutes for eating and recreation.

British factory owners who were looking for cheap labour soon extended their activities in India and the Industrial Revolution gradually spread in our country with all its illeffects on the weaker section of the Society. Employment of women and children of tender age for even 15 hours a day in the most unsanitary and deplorable condition was the order of the day. No attention was paid to safety, health and welfare of the worker and the employer believed that they owed no such obligation. The need for adding welfare amenities to contractual relationship between employer and the worker had to follow the same long drawn pattern as in England and the State had to intervene using its persuasive and legislative powers.

The first Indian Factories' Act was passed in 1881, but there was no provision under this Act or even its subsequent amendment in 1891 requiring the appointment of Inspectors to enforce the provisions of the Act. District Magistrates and Civil Servants were ex-officio Inspectors. The Factory Labour Commission 1907 severely criticised this system of inspection by District Magistrates who had neither the time nor the knowledge for the job. It was only in 1911 that a special provision was made for the appointment of Factory Inspectors.

The existing Factories' Act 1948 is an aftermath of a number of commissions and committees appointed prior to 1948, important amongst which were Whitley Commission 1928, Bhor Committee 1946 and Rege Committee 1946. The Whitley Commission, in taking note of the varying conditions in different establishments recommended that the more indifferent employers might be brought at least upto the general level which was much below what was provided by progressive employers. It favoured consolidation and extension of the principles already recognised in the Factories' Act in the clause dealing with the general health, safety and welfare of the operatives. It did not desire to overload the Act, but sought a method by which Governments could secure a uniform minimum standard of welfare where the nature of the process carried on or the special conditions and circumstances of employment demanded it.

The Rege Committee, while recognising that some aspects of welfare had been receiving attention in individual centres/establishments mainly from local associations of employers, referred to the effect of welfare

if provided, were likely to promote a feeling amongst the workers that they stake in the industry as much as anyone else and reduce labour turnover and eeism and stabilise an economically efficient working force.

Besides the various commissions cited above, the impact of ressure from the Society and men of literature in the growth and pment of Industrial Health and Safety Legislation has been a significant The horrible conditions under which children of 8 and 10 years were ed as CHIMNEY SWEEPS has been immortalised by Charles Dickens in his Twist. A note has also to be taken of the role played by voluntary isation. In fact, in many countries, voluntary health and safety isations even preceded the legislative action. The Mulhouse Accident ction Association in France dates back to 1867. The German Mutual Accident ction Association came into existence in 1884. The National Safety Council ited States was founded in 1913. The British National Safety First iation (now the Royal Society for Prevention of Accidents) however came existence only after the war of 1914 to 1918.

In Asia, Japan was the first country to be industrialised and the ese Industrial Welfare Society was formed in 1928. In India the Safety Association of India came into existence in 1931. The Council of trial Safety was established at Bombay in 1955 and the National Safety il was formed in 19 .

Let us now examine in detail the working environment and the is faced by an industrial worker. These can be broadly classified into categories viz. (i) Physical Hazards, (b) Chemical Hazards, (iii) Biological ds and (iv) Psychological Hazards.

CAL HAZ RDS:

Certain environmental conditions in the factories such as rded machinery, defective flooring, poor layout, use of defective tools resort to unsafe practices by the workers give rise to injuries and nts. It is impossible for a worker to work in such congested workrooms t getting involved in an accident which may result, besides loss of working either in a disability by way of loss of limb or even life. Besides machine es there are other physical hazards in the working environment to which any attention is paid. These are (a) Heat and Humidity, (b) Lighting,

xposure to certa (d) Excessive noise and vibrations.

PHYSICAL HAZARDS: Certain environmental conditions in th factories such as unguarded machinery, defective flooring, poor layout, u defective tools and resort to unsafe practices by the workers give rise t injuries and accidents. Accidents disable the worker and thus reduce h productivity. It is impossible for a worker to work in such congested wo rooms without getting injured. Whenever he does meet with an accident, t usual explanation put forward by the Managements and Supervisor is that t worker should have been careful. In fact, it is the Management which sh be careful to provide adequate safety measures. Besides these, there are physical hazards in the working environment which pose problems of health reduce his productivity. These are (a) Heat and humidity, (b) Lighting, (c) Exposure to certain radiations, (d) Excessive noise and vibrations.

HEAT AND HUMIDITY: Blessed as we are in this tropical cou with plenty of heat and sunshine, all of us are exposed to some heat str one time or other. But an industrial worker has to face additional heat humidity in the workrooms arising either from the processes or because of of ventilation in the workrooms.

Exposure to excessive heat occurs in industries dealing wit hot processes. Such heat exposures may be either of (i) hot-dry type or (ii) warm-moist type. In hot-dry industries such as steel mills, forge s etc. heat escapes mainly by radiation and convection from the processes a equipments in the surrounding workplaces. Workers exposed to such condit maintain their thermal balance by evaporation of sweat. Warm moist type heat exposures occur in cotton mills, dye houses and deep mines where the worker finds it difficult to dispose off the heat of his own body metaboli through the normal process of perspiration. The high moisture content of the atmospheric air in these situations prevents rapid evaporation of perspiration causing great discomfort to the worker. Under such conditio heat stress the productivity gets adversely affected and these workers ma suffer from disorders like (i) Heat Stroke, (ii) Heat Exhaustion and (iii) Heat Cramps.

HEAT STROKE: Heat Stroke is a condition in which the heat regulating centre in the brain fails with the result that there is total stoppage of perspiration in the affected person. His body temperature starts rising and may eventually go upto 110°F. Unless promptly treated t condition may prove fatal. Under-nourishment, old age, alcoholism and la of acclimatisation are predisposing factors.

HEAT EXHAUSTION: Heat exhaustion is a condition in which

system is not able to work with that much speed which is required to supply enough blood to his muscles. Such cases complain of nausea and vomitting and may pass on to the stage of unconsciousness. They do perspire but not sufficient enough.

HEAT CRAMPS: This is a further stage of the former where excessive perspiration produces a depletion of salt and water in the body. Such workers get painful contractions of the calf and abdominal muscles. Provision of cool drinking water, adequate rest pauses wherever necessary and acclimatisation through gradual exposure to heat, helps a great deal to prevent this condition. As far as possible avoid employment of elderly and weak persons on such job. Since the average daily intake of salt in an Indian diet is high supply of salt tablets on a <u>routine basis</u> is not necessary.

PREVENTION: Heat escaping into the environment from hot process can be controlled in insulation of hot surfaces, shielding against radiant heat and through provision of local exhaust ventilation at the workspot. Improvement in general ventilation is also helpful. Spot cooling of hot objects to be handled like boiler ash can be tried in some situations. Isolation of hot processes or use of personal protective devices e.g. asbestos or aluminised overalls, gloves etc. may be tried. Unlagged steam pipe lines and closure of existing windows for security reasons is the commonest cause of additional heat. Proper lagging on steam pipes, even though economical in the long run, is most often neglected.

No standards have been laid down under the Factories' Act in respect of maximum or ideal temperature in the workrooms. In respect of Textile Industry, according to an agreement arrived at by the <u>Indian Central Cotton Committee in 1950</u>, the dry bulb temperature in the loom shet shall not be less than 5°F and more than 10°F over the Wet Bulb and the relative humidity shall not exceed 54%. The dry Bulb temperature should not exceed 88°F except on occasions and temporary vagaries of climate. The minimum air changes in the loomshet shall be 12 per hour.

LIGHTING: Human behaviour, performance and achievement are the end results of seeing. Illumination levels can be measures with an ILLUMINATION METER and are expressed in the Foot Candles or Lumens. Poor Illumination and glare lead to accidents and strain on the eyes, neck and back muscles with consequent physical and psychological fatigue. Recommended values of illumination levels for various industrial operations are available. As per Factories' Act and Maharashtra Factory Rule No. 35 there should be a minimum ... in the industry and 30 Lux at the

INFRA RED RAYS: Exposure to infra red radiation is very common in glass industry and near the cupolas and furnaces. Infra red radiation is readily absorbed by the surface tissues and therefore does not inflict any deep injuries. However, with a continued exposure eyes may suffer even well [illegible] the level that causes general discomfort to other parts of the body. It causes CATARACT of the lens in the eyes. Suitable eye protection glasses should therefore be provided. Use of reflective screens of polished aluminium sheet near the source is another method.

ULTRA VIOLET RADIATION: Health hazards from ultra violet radiati[on] are superficial injuries to the skin and eyes. There may be a considerable ti[me] gap between the exposure and development of symptoms. WELDERS FLASH is a comm[on] occupational condition affecting the eyes of the workers and involving a lot of time loss. Industrial processes such as welding, produce considerable amount [of] ultra-violet radiation. Substances like ozone and oxides of nitrogen are also produced from the action of this radiation on air. A high concentration of oz[one] and oxides of nitrogen have been found in the room where arc welding is carri[ed] out. The practice of providing soothing eye drops cannot protect the exposed workers against occurrence of WELDERS FLASH, but may help to relieve the eye st[rain] and act as a psychological boost that something is being done for their eyes. These drops are no substitute for proper type of goggles which alone can save [the] eyes.

CONTROL MEASURES: Goggles, face shields, gloves, laggings, overa[lls] and boots should be provided to all welders and welder helpers engaged on a continuous welding job. Opaque shielding around welding booth is necessary to protect other persons. There is also a need to have a good general ventilatio[n] local exhaust for removal of chemical contaminants produced during arc welding.

XRAYS AND ATOMIC RADIATIONS: Xrays and atomic radiations are wid[ely] used in industry for determination of defects in castings, fabricated structur[es] and welds, or for detection of foreign material in packaged food etc. Radium along with zinc is used in the manufacture of luminous points used for paintin[g] the dials of watches, clocks and scientific instruments. All ionising radiations have a carcinogenic effect, shortening of life span, genetic mutations, reduction of fertility and cataract. Distance from the source is th[e] most easily applied principle for protection against radiation. Remote controls shielding through substances like lead, cadmium or boron are very helpful. For neutrons paraffin and concrete are most effective.

NOISE: Noise is an unwanted sound. Our drive for increasing

and increases the chances of accidents. Loss of hearing may not be recognised or felt by the workers immediately. It requires an exposure of anything between 3 to 10 years. It will also depend on individual susceptibility. To prevent hearing loss, the noise level should not exceed 85 db (decibel) at frequencies ranging from 300 to 2400 c/s per second for an 8-hour exposure. Harmful effects depend on a number of factors viz. (a) individual susceptibility, (b) noise intensity, (c) Total length of exposure, (d) length of exposure at any one time, and (e) Whether noise is continuous or interrupted. The roar of an oil burner or the rumble of a train is made up chiefly of low frequency sounds. On the other hand, the noise of escaping steam or a whine of pneumatic tools is made up predominantly of high frequency sounds. The noise from industrial machinary is usually concentrated in middle frequency range.

The 1976 Amendment of the Factories' Act includes NOISE INDUCED HEARING LOSS as a notifiable disease. It therefore becomes obligatory for employers to undertake measures to prevent exposure of employees to excessive noise level which may cause this disability. The Amendment unfortunately does not lay down the permissible exposure limit of noise in the terms of decibles nor does it give any details about the method of examination for the affected workers. Hearing loss is a defect which an individual worker himself can perceive and on audiometric examination would prove or disprove his contention. It is therefore necessary that an examination to test hearing power of employees is carried out at the time of recruitment and repeated at specified intervals so as to detect such cases at an early stage. This is now a common practice in all Western countries where compensation for Occupational Deafness is quite high. Since the loss initially affects high frequencies many workers do not feel handicapped until the disease progresses further.

Following methods can be applied for control or reduction of noise, (a) Control the noise at the source through good engineering design, (b) Substitution by less noisy processes such as welding instead of riveting, grinding instead of chipping etc. (c) Isolation: Shifting noisy machines to areas where few people work. Well insulated partitions and tightly closing doors may be installed in that area, (d) Use of sound absorptive materials, (e) Use of ear protectors such as ear plugs and ear muffs and (f) Rotation of personnel.

VIBRATIONS: Rapidly revolving machineries such as pneumatic drills, turbines etc. give rise to vibrations which may affect workers employed on such jobs. Pneumatic drill operators are known to suffer from muscular cramps in the hands, a condition known as Raynaud's phenomena - a disease which occurs

through mouth by way of ingestion. Absorption through skin may also occur in respect of certain chemicals. Broken skin hastens absorption. However, subs like hydrogen cyanide are absorbed even through an unbroken skin if enough concentration is present in the air.

Exposure to dust occurs mainly in mining and quarrying industry. It also occurs in Textiles, Chemicals and Metallurgical industry. Grinding a pulverising operations generate a lot of dust which would be inhaled depending the quantity, duration of exposure and above all the size of the particle. As a rule, particles bigger than 5 micron size are arrested in the nose and upp respiratory passages and are continuously swept through the mouth by ciliary a and finally swallowed. Particles below 0.1 micron are too small to be trapped the alvioli (lungs) and are therefore breathed out. It is only particles rang between 5 to 0.1 micron which reach upto lung and remain in the alvioli. Vap from Liquids of low volatility like organic solvents aniline compounds and insecticides and fumes from gases like sulphurdioxide, hydrogen sulphide and carbon monoxide are also absorped through inhalation.

Ingestion of toxic substances results from eating contaminated food - home food kept in dusty workrooms and through the habit of eating witho washing the hands properly. It however plays a minor role and is generally s where Housekeeping is poor and the workers are not provided with adequate was facilities. Inhalation is by far the most important route of absorption.

Effects of chemicals on human system depend on the (i) Concentr of toxic substance in the air, (ii) Duration of exposure, (iii) Toxicity and (iv) Individual susceptibility. These effects could either be local or syste or both. Caustic liquids (strong acids and alkalies) cause irritation of skin. The degree of skin irritation would vary from mild redness or itching to seve dermatitis - CONTACT DERMATITIS - which may even get infected and give rise t septic eczema or boils. Some chemicals are known to produce allergic dermatit In case of volatile substances and gases, the irritant affects the eyes, nose, throat and upper respiratory passages.

Symptoms of poisoning can either be acute or chronic. While the former occurs when large doses of the chemical are absorped, the latter is th result of repeated or continuous exposure to small doses. Chronic poisoning is far more significant than acute. More than one organ of the body is generally involved, such as lungs, bone marrow, nervous system, liver, kidneys, skin etc. When more than one toxic substances are present in the air, there may be synergestic effect also.

THRESHOLD LIMIT VALUES (TLV) Since it is almost im...

mum allowable concentrations (MAC) of the American Standard Association and of the American Conference of Government Industrial Hygienists have been down for this purpose. These limits should be used as guides and should not garded as absolute levels between safe and dangerous concentrations as personal ptibilities differ. These are based on average concentration for an 8-hour sure for 5 days a week.

Many industrialised countries have evolved their own MAC and TLV es for different chemicals. In India however no standards have been prescribed ar except for Benzene which is 25 parts per million. The recommendations r the Factories' Act in respect of others are far too vague. In the absence ny demand either from the Government or from the Labour it will be a pious hope xpect the employers to carry out periodical air sampling and maintain ntifically safe and healthy conditions in the workrooms.

INDUSTRIAL EFFLUENTS: Waste products and effluents from some stries often contain harmful substance which may affect the workers or general population around. Minamata Disease, a condition in which there oisoning from mercury was first reported in Japan where contamination of fish he Minamata Bay area from the effluent containing mercury resulted in an reak of Mercury Poisoning among the population around. Such a contamination eing reported of late in Bombay also.

CONTROL MEASURES: Wherever possible substances with proven ity should be substituted by less toxic ones such as use of methylchloroform richlorethylene in place of carbon tetrachloride as solvent, xylene and ne in place of benzene etc. Next step should be to isolate or enclose such esses. Examples are shot blast machines for cleaning castings and bottle ng chambers for organo-phosphorus insecticides. Many processes when ained in a negative pressure will prevent escape of contaminants into orkroom atmosphere. Change of technique such as use of steel shots in place nd for abrasive cleaning operations or use of wet method in rock drilling tions can also be tried.

Providing local exhaust ventilation is by far the best method eventing air contamination particularly where contaminants are given off operations confined to relatively small areas such as hot processes, tank , furnace, spray painting etc. Care should be taken to see that the exhausted oes not re-enter the plant. For this purpose the exhausted air has discharged well over the roof of the building to prevent its re-entry through

PROTECTIVE APPLIANCES: Wherever it is not possible to get rid of contaminants and also as an added measure of safety, use of personal protective appliances is recommended. These consist of filter masks, canning masks, breathing apparatuses like oxygen or airline respirators, goggles, gloves, shoes and overalls. It must however be remembered that these are a last line of defence and are in a way an acknowledgement of defeat in the sense that these have to be used because the hazard cannot be eliminated. These are but frail barriers between the worker and the hazard. The reluctance of the workers to use such appliances on various grounds is well known. The management has to ensure that not only these are readily available but that the workers are trained and motivated in their use. A Barrier Cream to be applied to the exposed parts of body with a view to avoiding contact with chemicals can also be used for some chemicals.

MEDICAL SUPERVISION: A programme of medical surveillance on the exposed employees is of paramount importance for timely detection of any Occupational Disease likely to arise. The programme should include a thorough medical examination and biochemical tests involving examination of blood, urine, stool and other body fluids for evidence of chemicals. It is necessary that the Doctor should have adequate knowledge and motivation in Occupational Health. Early signs of many Occupational Diseases are similar to those of non-occupational origin and it is only through a proper appraisal of medical records and follow-up that these can be detected in time before the condition may progress upto a stage when it becomes irreversible e.g. Industrial Deafness.

COMPENSATORY ALLOWANCES: Practice of giving compensatory allowances in cash and kind (milk, banana, vitamin tablets, jaggery, lemon, coca cola, soda water etc.) as a measure to prevent the harmful effects of chemicals is not only popular with the Trade Unions but also with the Employers. Employers perhaps view it as a method to cut the long story short. Health cannot be bartered with money. Neither milk nor vitamins are an antidote for an Occupational Disease. It is true they do provide additional calories and nutrients to the depleted intake of the workers. But there is no scientific evidence to suggest that milk in the stomach will act as an antidote to dust or fumes in the lungs. These do not even act as a prophylactic. Such practices only help to perpetuate the hazardous conditions in the Industry rather than their amelioration.

BIOLOGICAL HAZARDS: These are limited to industries where the raw materials are sometimes contaminated with bacteria and the infection is transmitted to the worker. Wool Sorters Diseases - a pneumonia like

affect the workers. Gynaecomastia – enlargement of male breast – a disease affecting male workers handling female hormones is recognised as compensable occupational disease in many countries of the world.

OCCUPATIONAL DISEASES: Occupational Diseases are as old as human civilisation. The primitive man used to get his food from hunting and was exposed to hazards of wild life. The agricultural man has comparatively less hazards but is not totally free from them. Ayurveda records a wasting disease of lungs occurring among masons and stone dressers. Industrialisation has exposed the workers to many serious hazards whose nature and extent depends on the toxicity of materials used and the duration of exposure to these substances, the nutritional status of the workers and above all on the individual susceptibility.

Certain occupational diseases are notifiable and the afflicted workers are eligible to get compensation under the Workmen's Compensation Act 1923. For a list of the diseases declared as notifiable under the Factories' Act 1948 and Maharashtra Factory Rules 1960, a reference may please be made to these Acts. Important among these are Poisoning caused by metals like Lead, Mercury, Chromium, Arsenic, Asbestos, Chemical Compounds like Carbon disulphide, Benzene, Amino derivatives dyes, dusts like Silica, Bagass, Atomic radiations and other Cancer producing substances. Four more diseases have been added to this list under 1976 amendment. These are noise induced hearing loss, oil acne, contact dermatitis and byssinosis.

PNEUMOCONIOSIS: This is a disease arising from exposure to various toxic dusts of which SILICA is the most common. It occurs among miners, stone cutters, grinders, pottery and ceramic workers, glass blowers, sand blasters and in many other operations. Higher the free silica content of the dust more are the chances for the disease. Particles of silica get deposited in the lungs in the form of fine nodules which, with passage of time, conglomerate until the whole lung becomes a veritable piece of small stones. The condition is progressive one causing shortness of breath and repeated bouts of infection in lungs which affect the working capacity. Most cases ultimately develop TB of lung due to super added disease. The disease is notifiable under Section 89 of the Factories' Act and also compensable.

LEAD POISONING: Common route of absorption of lead is through inhalation through ingestion may be responsible for some cases. Typical symptoms and signs are loss of appetite, feeling of weakness, vague paid in stomach and paller of face from anaemia. There may be alternate bouts of diarrhoea, followed by long periods of constipation, finger nails may become ... on the gums, though this by no means is a

(lead palsy) defective vision, loss of memory, falling of hairs and sometimes high blood pressure. The disease is notifiable and a compensatable one.

BYSSINOSIS: Exposure to cotton dust mainly in the Carding and Blow Room Departments of Textile Mills and in the Ginning and Pressing factories causes a disease of the lung which is known as Byssinosis. This disease is so far neither notifiable nor included under the Workmen's Compensa Act. However, a proposal for its inclusion is before the Government. It requ anything between 10 to 15 years of exposure for the disease to occur though ca occurring after shorter duration are not unknown. Early symptoms are mild irritation of throat and a feeling of tightness in the chest on Monday morning (after a weekly holiday). The symptoms disappear when the worker is back home. As further exposure continues the symptoms occur on Tuesday, then Wednesday and so on until the worker finds difficulty in breathing on all days of the week. Tuberculosis infection supervenes and 50% of these cases ultimately die of tuberculosis. On transfer to a non-dusty department, early cases would show so improvement but the symptoms would soon reappear if they go back to their original job.

Prevention of occupational diseases lies mainly in providing hygienic conditions of work in the factories so that workers do not get an undu exposure to harmful substances. Proper selection of workmen through pre-placem examinations, periodic sampling of air in the work rooms, use of protective appliances and periodic medical examinations are recommended to ensure their early detection so that the affected workers can be withdrawn before it is too l

PRE-PLACEMENT EXAMINATIONS: Medical examination of workmen at the time of recruitment or prior to their being placed on certain jobs is known as Pre-placement examination. Under the Factories' Act such examinations are compulsory only for certain hazardous operations listed under Section 87 of the Act. Here also the law permits such examinations to be carried out within seven days of their appointment. Such workers have also to be re-examined after specified intervals of time varying from 3 to 6 months.

It is now a common practice with most of the big industrial establishments having a medical officer to examine their new recruits for fitness. The important points to be noted here are whether the worker is suffering from any infectious disease which may be a source of danger to co-workers or whether he has any bodily defect which may hamper his capacity to work or which in course of time may make him a liability to the company. Each company has its own standards of fitness regarding height, weight, eye sight etc

INDUSTRIAL SAFETY

"In a country as populous as ours, there can be danger of a tendency developing to discount the value of human life. Its loss in accidents or through the slow and agonising process of an occupational disease may not stir the community as much as it would in countries with chronic labour shortages, though to the near ones it is a tragic occurrence. Relief gets organised after the event, but prevention gets side-tracked". Thus observed the National Commission on Labour in their final report submitted to the Government of India in 1968. The present position of Safety in Indian Industries still continues to be the same even though the above report is now 12 years old.

Ever since we embarked on industrialisation, accidents in the industry are on the increase. Besides causing bodily injury and pain to the injured worker, accidents incapacitate him for a varying period of time, depending on the seriousness of the injury. Quite often these result in a permanent disatlement of death. Accidents may also damage the machinery and affect the smooth flow of production. These are thus a drain on Nation's economy and a loss which we can easily avoid. The movement to reduce accidents which originally started on humanitarian grounds is in reality a problem of reducing the costs to the industry. Direct costs are expenses incurred on medical treatment of the injured and the cost of compensation or disablement allowance to be paid to the worker. Indirect costs comprise of time lost by co-workers, supervisors and others involved in inquiring into the cause of the accident, filling the report, complying with other legal requirements and damage to machinery.

Various official and voluntary agencies have of late been able to bring about some consciousness in respect of accident prevention, both in the minds of employers and employees alike. The Factory Inspectorates in the States and the National Safety Council and its various chapters are on the job. In Maharashtra the Council of Industrial Safety (Maharashtra Branch of the National Safety Council) has been carrying out numerous activities for past two decades. All the same, our existing figures when compared with other industrialised countries of the west are still very high.

YEAR	FATAL	NON-FATAL	TOTAL	RATE PER 1000	F.R. LAKH MANDAYS.
1970	613	287560	288173	67.56	23.61
1971	635	324545	325180	75.67	26.53
1972	655	285257	285912	63.63	21.98
[illegible]	[illegible]	[illegible]	286017	58.49	20.51

There is one more agency viz. Employees' State Insurance Corporation which should be actively interested in reducing the accidents because of the heavy drain these cause on its funds by way of payment of TDA (Temporary Disablement Allowance) during the period the injured worker is off work and compensation in case of permanent disability or death. Regretfully Employees' State Insurance Corporation has so far not taken any positive step in this direction on the lines of what is prevalent in some western countries. One may note here that it was because of the attention drawn by private Insurance Companies in the past and by the social security organisations later that the safety movement in the west got a fillip. With a view to providing an incentive to the employers, these Insurance Companies used to raise or lower the premium payable depending on the number of accidents in a client company. This attracted many employers in Safety because to them it turned out to be a rewarding proposition. The ESIC in India charges the same premium, irrespective of the fact that client Company A may have a good safety record and B a poor one.

ACCIDENTS ARE CAUSED, THEY DO NOT HAPPEN:

Many believe that accidents are inevitable for those who work in the industry. They therefore take accidents as a natural happening or a calamity, something which is beyond their control. This however is a grossly mistaken and a fatalistic view. Behind every accident there is either an unsafe condition or an unsafe act. It is said that in majority of accidents (85%) both these factors are responsible. If one exercises vigilance to eliminate unsafe conditions and at the same time control unsafe acts, the possibilities of accidents could indeed be reduced to zero.

UNSAFE CONDITIONS arise from unguarded or poorly guarded machines, poor housekeeping, lack of adequate safety devices and use of defective tools and implements. Uneven and broken floors, presence of sharp objects like nails, glass pieces on floors or their obstruction with unwanted objects, spillage of water, oil and other substances on floors, parts of machines jutting out, poor layout of the machinery etc. contribute to poor housekeeping and consequently to accidents. These can certainly be controlled to avoid accidents. Reasons of UNSAFE ACTS are hurry, taking chances, using unsafe methods, lifting articles above one's capacity, neglect to replace the guards after repairs to machines, neglect to use personal protective appliances, disregard of safety rules, tampering with guards and locking devices etc.

Careful analysis of the above will show that if efforts are made to eliminate unsafe conditions and unsafe acts, there will be no cause for ac-

programme under which all hazards should be listed out in the form of a Safety Manual. Maintenance of the machinery and of the guards installed and a regular inspection of these guards is also necessary. The management should also introduce some safety incentive schemes either departmentwise or for the whole factory to enlist enthusiasm and support of the workers in this respect. They should organise Training Programmes for the workers and supervisors with a view to improving their consciousness. The workers should be impressed that working safely is in their own interest. If they remain absent even for minor injuries, they would lise a part of their wages besides the pain and suffering they have to undergo because of accidents. A programme of Safety Week organised on a yearly basis is useful. Although Safety Committees are not yet statutory, these be established in each factory and the discussion in these meetings be arranged in a businesslike manner.

Judging from any angle, legal, material or moral, Industrial Safety is a responsibility of the Management. Unless the management is earnest to provide safe working conditions, no amount of compulsion can be of any avail. Since the primary aim of any industry is to make profit, and more profit, unless the economics of safety are properly understood and explained to the management, the slogan "Safety Pays - It Costs nothing" remains only on paper and the Management's interest in safety gets restricted to merely complying with the letter of the law or from public relations point of view to create an impression that they are a progressive lot. This is one reason why there is a wide gap between what managements preach and what they practice.

The next in importance is the apathy on the part of Workers and Trade Unions. How to involve them and to create in them an awareness that their safety at work is as much important, or perhaps even more important, as getting higher emoluments, that unsafe conditions of work or unsafe work practices are not a matter to be bartered against money, is indeed a problem of much wider dimensions. One really wonders at the neglect and complacence exercised by the Trade Unions in this direction.

ACCIDENT CAUSES: All accidents irrespective of their nature must be properly investigated and correct cause found so that remedial measures can be undertaken to prevent their recurrence. Accidents from UNSAFE CONDITIONS can be broadly classified into (i) machine injuries, (ii) material handling, (iii) Defective tools, (iv) Poor Housekeeping, (v) Electrical causes, (vi) Falls, (vii) Non-usage/non-availability of protective appliances etc. Some accidents are due to UNSAFE ACTS on the part of the workers (Personal Factors) important among which are (i) Hurry, (ii) Taking risks or a chance, (iii) Lack of job

Engineering Industry defective tools or machine injuries may be responsible for a majority of them.

RECORDING AND REPORTING: All accidents must be recorded in a systematic manner so that the performance can be compared from year to year. In factories where there is no Safety Officer, such recording is generally done by the Lâbour or Personnel Department. Recording of accidents is obligatory under the Factories' Act as well as E.S.I.S. Act in the proforma prescribed under these Acts. Whereas under the former only reportable injuries are to be recorded, the latter requires recording of all injuries from trivial to serious.

Following are the indices commonly used for purposes of compilation and comparison.

REPORTABLE ACCIDENTS. Under Section 88 of the Factories' Act accidents which cause death or any bodily injury by reason of which the injured person is prevented from working for a period of 48 hours or more immediately following the accident, the Manager of the factory shall send notice thereof to the appropriate authorities. Such accidents are also known as LOST TIME Accidents.

FREQUENCY RATE is the number of Lost-time accidents per one million manhours of work.

SEVERITY RATE is the number of days lost per one million manhours of work. While calculating the manhours worked, the actual hours of work put in including the overtime and hours worked by supervisory staff should be included. Both these can be worked out as shown below:-

$$\text{Frequency Rate} = \frac{\text{Total No. of lost-time accidents} \times 1{,}000{,}000}{\text{Manhours worked}}$$

$$\text{Severity Rate} = \frac{\text{Total number of days lost} \times 1{,}000{,}000}{\text{Manhours worked.}}$$

MANUAL LIFTING: Although human muscle power is much inferior to the power available from any machine, we in India use the method of manual transport of load on a wide scale. The question as to how much weight can a worker carry either in hand or on his back without damage to his health has been the subject of great debate at the I.L.O. which is concerned with improving the conditions of work. Their recommendation on the subject which has so far been accepted by one State viz. Maharashtra lays down 55 kg. as the maximum weight to be carried by an adult male worker. Limits in respect

ACCIDENT PRONENESS:

Nobody wants to get injured. Not even a child. All the same one does come across workers who meet with accidents more often than others. The term accident proneness is sometimes used for identifying such persons. Psychol[illegible] once believed that there were some individuals who because of their psychologi[illegible] make-up are accident prone. This observation was based on the fact that the c[illegible] for accidents in such cases was an unsafe act on the part of the worker. A detailed study of a large number of accidents in an organisation would however reveal that in majority of accidents there is a combination of an unsafe act as well as an unsafe condition. In fact the latter may be predominant and even induce the worker to adopt an unsafe act. For instance, if a ladder with a br[illegible] rung and patched up by tying a string is supplied to the worker, he is likely t[illegible] do the same to further rungs that might break in future. While the cause here [illegible] an unsafe act, it has been motivated by supply of an unsafe equipment. Further, the root cause of unsafe acts in many cases may be poor job knowledge, inadequ[illegible] instructions, lack of safety education and awareness or some physical handicap in the worker such as poor eyesight, hearing power or muscle power or height required to do a particular job. All these factors should be excluded before a worker is labelled Accident Prone.

FAMILY PLANNING.

Increasing population is eroding into all our efforts at national development. The problem has become more acute during past two decades not because of any increase in the birth rate but due to the gradual decline in the death rate. While death rate in our country over past 70 years has declined from 43 to 14 per 1000, the birth rate has come down only from 49 to 38 per 100[illegible] Thus our annual growth rate which was less than 2% before independence now stands at 2.4% creating a wide demographic gap which has to be bridged by an adequate economic growth to sustain this increasing population. It is estimate[illegible] that at present rate of growth, India's population would cross a 1000 million mark at the turn of the century - a situation wity unimaginable consequences. Among the developing countries, India was the first to recognise the population problem as early as 1951. The Government of India has ever since laid increasing stress in its 5-year plans on reducing the birth rate and has set an objective of bringing it down to a manageable proportion of 25 per 1000 per annum by 1978. Of late, it has even liberalised abortions under the title 'Medical Termination of Pregnancy'. But the progress has not been satisfactory. Since there are no signs of fulfilling the above target the Ministry of Health

ow:

1. Industry employs the largest number of men and women in the reproductive age-group.
2. It has its own Welfare and Medical services through which it can reach each and every employee.
3. Industrial units being business organisations can organise their programmes more efficiently than what the Government can.
4. Industrial workers are a compact group exposed to modernising influences, have higher levels of income, education and aspirations and can appreciate economic and social advantages of a small family norm better than the general population.
5. Adoption of a small family norm helps in prevention of social problems in the industry, reduction in absenteeism from work and also reduction in accidents in the factory.
6. The Family Planning programme thus helps the industry indirectly in bringing down their costs on services such as housing, recreational facilities, medical facilities, etc. which they have to provide at a considerable expenditure.

There are a number of other indirect benefits like the Multiplier ffect on rural population and others, but the most important benefit that will crue over the years is a solution to the growing problem of unemployment, which posing a serious threat to our industrial peace. The industry thus owes not only moral and social responsibility but, if I may be permitted to say even a terial responsibility in lending their helping hand to the nation in this task.

A number of industrial organisations have accepted this responsibility d are doing excellent work in propagating Family Planning not only among their ployees but also in the community nearby. The methods adopted by them can be ll emulated by those who are not yet involved in this movement.

Family Planning essentially consists of two components -) motivation, and (b) provision of contraceptives and sterilisation services. ether the implementation of the programme in Industry be entrusted to medical partment or to welfare department is a question which depends on the rcumstances prevailing in the industry, its size, resources etc. Wherever both ese agencies exist they should work in close cooperation. It must however be membered that unless the manager or the top executive at the factory takes tive interest in the work and himself reviews the performance, things move very owly indeed. There are many instances when one finds that after an initial for a year or two, the response drops down and nobody bothers further.

Following steps should be taken to organise an effective Family Planning programme in Industry:

1. To undertake educative propaganda through display of posters, distribution of informative pamphlets, film shows, exhibitions, meetings of the workers in different departments. While some publicity material can be had from the Government free of charge additional material based on conditions in each factory, may have to be prepared locally.
2. Family Planning Social workers should be permitted to approach employees in the working time whenever required.
3. To undertake a Family Planning survey of the entire employee population of the factory.
4. To acquire and store adequate stock of contraceptives for free distribution among the employees.
5. To arrange for vasectomy operations on the factory premises or make such arrangements with a nearby government clinic. It may be noted that Maharashtra Government gives a grant of Rs.51/- to any industrial establishment per vasectomy operation if the same is performed at the medical clinic of the establishment.
6. To grant monetary incentives for sterilisation operation on the employee or his spouse.
7. If the responsibility for family planning work is assigned to the Welfare Department, it is necessary that the Medical Officer, even if he be part-time or full-time must be involved in the programme.
8. Provision of free medical care for any complication that might arise from adoption of family planning methods.
9. Periodic follow-up of the employees practising family planning methods.

Assistance from the Government with regard to supply of contraceptives, posters, films etc. is available. Voluntary agencies like the Family Planning Association of India having branches all over the country also offer such assistance, including motivation and supply of contraceptives in our own city the FAMILY PLANNING UNIT OF THE BOMBAY MUNICIPAL CORPORATION renders all assistance, if requested. Proper record keeping of the work carried out is very important for evaluation and assessment of work.

Our population is increasing by leaps and bounds. Starting with 238 million in the year 1901, we have reached a staggering figure of 647 million by

REFRESHER COURSE ON OCCUPATIONAL HEALTH

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ACCIDENT PREVENTION

"Accidents Start where Safety Stops"

INTRODUCTION :

It is said that there would hardly be a worker who has not been disabled from work for more than 48 hours following an accident if he has served his complete life time in the industry. A mannual worker might have had many injuries needing first-aid. If the statement is true, it reflects the seriousness of the problem.

From the records it is observed that over 3 lakhs reportable accidents are recorded every year in the factories alone in India out of which about 600-700 cases are fatal. During 1978, nearly $3\frac{1}{2}$ lakhs were recorded which included 800 fatalities. This huge figure, by itself, explains the gravity of the problem. Apart from the injuries, received by the workers during the course of their work, the workers are also affected by the toxic effects of the chemicals, fumes etc., if present in the environment. As medical officers, you have also to look after the health of workers during the course of their employment.

An accident may be defined as an unplanned, uncontrolled and undersirable incident, which may or may not result in an injury. From this definition, it could be said that injuries are always the result of an accident. The injuries may result in partial or permanent disability and may even cause fatality. When a worker is injured, it is labelled as an accident and the workers are made to believe that everything possible has been done to prevent the accident and no one is responsible for the incident or, in other words, nothing is required to be done to prevent similar incidents.

ACCIDENT THEORIES

Various theories were evolved about the trend of accidents and some of them were :

(i) "Pure Chance Theory" : Under this theory, an accident was considered to be an Act of God. Workers were made to believe this theory and nothing was initiated to prevent the accidents as it was said that the accidents cannot be controlled.

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(ii) "Biased Liability Theory" : Under this theory, it was said that once a person sustains injury, the chances of his getting injured again are either decreased or increased. If the probability has increased the theory is known as "Contagious Hypothesis" and if the probability is decreased it is called "Burned Finger Hypothesis".

(iii) "Accident Proneness" : Under this theory it is said that there are certain people who are liable to get injured more than others. However, the accident data does not lend any support to this concept. It may be said that people are trying to take advantage of this concept in order to evade steps for accident prevention.

(iv) "Adjustment Stress Theory" : Under this theory it is said that people who fail to reach some sort of adjustment with working environments may have more accidents than others.

(v) "Domino's Theory" : This theory was evolved by Mr. Heinrich, who has investigated a number of accidents, came to the conclusion that there is sequence of factors before an injury takes place (the factors were shown in the form of a Domino) and if any of the preceeding factor is controlled, injuries do not take place. Mr. Heinrich had shown the factors in the form of the Domino's :

Ancestory or Social environment - Fault of Persons - Unsafe Acts / Unsafe Conditions - Accident - Injury.

Types of Accidents :

Accidents have been classified in two broad categories : (1) Reportable (2) Non - reportable. Under the Factories Act, if a person is disabled from work for more than 48 hours following an accident, the accident is treated as reportable. The reportable accidents may be minor, serious and fatal. First-Aid cases and where the persons are not disabled for more than 48 hours are said to be non-reportable accidents.

Accidents and Systems :

The reliability of a system is the probability that the system will satisfactorily perform its intended function under given circumstances for the intended period. In any plant the output is dependent upon the efficiency of the men and the machines and it also affected by the materials, methods and environments. An accident would affect the output of the plant, and the efficiency of the system can be maintained by :

i) providing and maintaining safe plant and equipment.

ii) proper guarding of machinery.

iii) planning and arranging processes with due regard to safety.

iv) training of workers.

v) bringing out manuals, codes etc., for the safe methods of work.

vi) enforcement of safety provisions.

vii) arranging inspections to discover and correct the hazards.

viii) providing safety minded supervision and motivating the supervisors. - safety officers

ix) motivating the workers to follow safe methods of work.

x) investigating accidents to find the factors for the same and implement remedial measures to prevent the same.

Safety should be a habit.

Accident Prevention Techniques :

No safety programme would be effective without involvement of all concerned i.e. management, supervisors and the workers. Hence apart from the interest taken by the management, workers are to be motivated to adopt the safe systems of work. A number of schemes have been formulated for the active participation of the workers and one of them is the 'Safety Stewardship Scheme' followed in some factories. Under this scheme some of the personnel are trained in safety and called safety stewards. In U.K. the legislation has provided for 'Safety Representatives' who take active steps for the safety of the workers. In Sweden, in any factory employing more than five persons, the workers can elect any person to be their safety representative, and this safety representative has powers to stop work, if the conditions are not considered to be satisfactory and the work can only be started with the approval of Factory Inspector.

Medical profession has been cooperating with the Safety Department in the accident prevention programmes. The improved medical facilities have helped in reducing the death rates and at times preventing an injury to become reportable. Doctors can influence the managements to take more interest in the safety. They have all the records to know the trend of the accidents in the factory and can help the safety department in the accident prevention.

Unsafe Conditions

Cause → Hazard

Unsafe acts

Omission

D Attending to Hygiene — [illegible]
(C) [illegible]
(D) [illegible]

Any injury is first attended by the Health Department and while rendering first-aid, a good nurse could obtain the cause of the injury, which could be made available to the Safety Department as during investigations often the facts of the case are distorted. Such a system may help in finding the correct preventive measures.

Doctors can also associate themselves with Safety teams and render valuable help. For example during inspection they can check the ergonomic factors i.e. identify the jobs which may create more stress or strain and suggest rest pauses or could suggest modifications on the machines-controls for better efficiency.

Medical officers can also play an important part in the Safety Committees as they can provide the valuable information about the trend of the accidents and express their concern about the unsatisfactory conditions, need for training etc.

CONCLUSION :

Accidents being misery and sufferings to workers and their families. A handicapped worker becomes a liability on the society and nation and everyone who can contribute towards the good cause of keeping the workers safe and healthy should do so. The medical profession has been lending good support so far, and is hoped that they would active their activities further in this direction. In conclusion, it is worthwhile recalling the words of wisdom of JJHENKE :

"And the end is that the workman shall live to enjoy the fruits of his labour; that his mother shall have the comfort of his arms in her age; that his wife shall not be untimely a widow; that his children shall have a father and that cripples and hopeless wrecks who were once strongmen shall no longer be the by-product of industry"

dent — frequency rate = Total No of accidents / Total no of man. hours worked × 1000 000

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dent rate = Total no of accidents / Average number of personnel exposed × 1000

dent severity rate = Total No of days lost / Total No of Man hours worked × 1000

tion — South [illegible] Man...
[illegible] — Regional ventilation

EFFECTS OF NOISE AND HEARING CONSERVATION PROGRAMME

SYNOPSIS

Noise may be defined as unwanted or undesired sound.

Decibel (dB) : This term is used to described the intensity of sound. The decibel indicates a sound pressure of 0.0002 microbar or dynes per square centimetre.

Frequency : The frequency of sound is the number of times a complete cycle occurs in one second. It is expressed in cycles per second (c/s) or in hertz (Hz).

Approximate noise levels :

Whisper 20 dB
Normal conversation 50 to 60 dB
Street noises 40 to 70 dB
Lathes 85 to 95 dB
Riveting on steel plates 130 dB.

Effects of noise :

Auditory effects of noise :

On short exposure to high intensity noise: This may cause sudden rupture of eardrum. The drum usually heals up if the tear is small.

On prolonged exposure :

A. Temporary Threshold Shift (TTS) : Exposure to noise can produce temporary hearing loss, or auditory fatigue. This can be seen from audiograms made on a person exposed to loud noise at different times of the day. The hearing becomes normal by the following morning. Most recovery occurs within an hour or two of the end of exposure.

Several factors can influence the development of TTS. These are :

1) The loudness of the noise
2) Whether intermittent or continuous noise, and the amount of rest period between exposures. Intermittent noise produces less shift than continuous noise.

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B. Permanent hearing loss : Loss occurs first in the 3,000 to 6,000 Hz band, usually with maximum loss at 4,000 Hz. At later stage, the loss spreads to other adjacent frequencies. Some persons are more susceptible than others for developing the hearing loss, particularly those who are aware that noise disturbs them.

Non-auditory effects of noise :

Noise can interfere with speech communication. This interferance is basically a masking process. For example, with a background noise of 50 dB, the maximum distance where ordinary speech can be understood is about seven feet. With raised voice level, this distance may go upto fourteen feet. Telephone conversation begins to get increasingly difficult when the background noise exceeds 60 dB.

Disruption of job performance and safety : As a consequence to interferance with speech communication and lack of concentration the efficiency and output may be reduced. Accidents can also occur under such circumstances.

Annoyance : The degree of annoyance is not necessarily directly related to the intensity of noise, as weak sounds are also sometimes annoying. Attitude of the mind and environment are important factors. But in general it is the loudness and the frequency which determines the annoyance.

Hearing Conservation Programmes :

An effective hearing conservation programme should be undertaken where exposure to industrial noise is capable of producing hearing loss. The object is to ensure that an employee's hearing is not affected during his working life to an extent greater than that usually occuring with age, and to preserve it at a level sufficient for normal speech reception.

Conservation programme is needed in situations where the hearing loss, as measured by audiometry, is more than 10 dB at 4,000 Hz. It is also indicated when the sound level in the working environment is more than 90 dB and there is difficulty

to communicate by speech.

The programme consists of :

a) noise exposure analysis,
b) engineering control of noise,
c) protection of hearing with ear defenders where necessary, and
d) measurement of hearing by audiometry.

Audiometry : In Industrial situations pure tone audiometry for air conduction is carried out. An audiogram taken during the preplacement medical examination serves as a reference level. Repeat audiograms can be taken at suitable intervals, depending upon the exposure to noise and the susceptibility of the person. Audiometry is useful detection of hearing impairment at an early stage, evaluation of the ear defenders and evaluation of other control measures.

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INDUSTRIAL INJURIES AND REHABILITATION

INTRODUCTION

At present there is insufficient data, even in advanced countries, available to provide categorical answers to many questions concerning the economic value of rehabilitation. Yet, Statisticians tell us that rehabilitation is an economic necessity.

Lord W. Beveridge in his book 'Full Employment in a Free Society" (1944 - London) said that 'Failure to use our productive powers is the source of an interminable succession of evils'.

We owe it both to the disabled and the community at large to spend a good deal more time and efforts in establishing an accurate cost-benefit analysis of the economics of rehabilitating the disabled.

In a year in which the pollution of atmosphere has been the subject of so much attention, one fact which has emerged clearly is the startline prevalance of respiratory illness in our society as a result of modern living and working habits.

There is no such adequate publicity to injuries caused by the mechanised industry. If a city like Bombay were hit by a monumental disaster and if 100,000 citizens were seriously injured and 5,000 of them permanently disabled it would be a headline news. But it is sad that human misery of this magnitude happens in our country every year. Because the wastage spreads over 365 days and over a wide area of the industrial belt of the country rather than being telescoped into one day and one place, there are no headlines.

INJURIES

According to the available statistics of the industrial hospitals, the permanent partial disabilities and temporary disabilities include

- Contusions and minor cuts
- Sprains
- Fractures and dislocations
- Hand injuries
- Peripheral nerve injuries
- Back-aches
- Amputations
- Paraplegia and Quadruplegia

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Contusions and minor cuts, and sprains :

It is rather unfortunate, this group should find its place in the above list. Many a finger, elbow and shoulder end in a stiffness due to improper treatment. Thus prolonging the disability period.

Hand injuries :

A curshed hand is one of the most common industrial accidents inspite of the good safety measures. The rehabilitation of the hand is always a terrific challenge to the treating personnel.

Paraplegia & Quadruplegia :

To-day notable results are being achieved in this field.

Mortality rate of paraplegics has dropped to below 5% and of the tetreplegics to below 20%, in well organised clinics. It is important to realise that the fate of a paraplegic is decided mostly in the first few hours after injury. Hence it is essential that early recognition of the injury and correct transport are taught to every-one concerned. Ideally, the patient should be treated in paraplegic clinics and besides medical calse, psychological care, social guidance and vocational guidance should be extended to the patient. In the course of treatment, which now- -days lasts on an average 7 to 9 months, the future will be as near as possible fixed to the rehabila ion plan.

Training of these severely disabled groups in traditional trades is to be rules out, as they don't lead to full re-instatement.

Amputees :

The rehabilitation of these patients should not be a difficult problem unless one is faced with multiple amputations of limbs or with other major handicaps.

Ideally, an amputation of a limb, especially the lower limb, should be done by an 'amputation surgeon' who is in touch with the osteo-myoplastic techniques. Also, it is important to remember that the modern Prosthetist can fit almost any stump and as such all joints that can be saved must be saved.

Back-ache :

Back injury and concomitant back pain account for more loss of time and production than any other traumatic event in industry to-day.

One of the most difficult parts in management of chronic low back strain is guiding the patient through the ups and down that always occur.

(a) Prolapsed intervertebral disc : is a popular diagnosis in acute and chronic back-ache. There is no question that the condition is relatively common but my feeling is that the diagnosis is often made on insufficient grounds.

The condition may arise as end result of degenerative changes coupled with postural and gravitational stresses, or may be traumatic in origin. The end result is the same - root pain with or without low back pain.

(b) Acute & chronic lumbo-sacral strain : Basically, this is the price we pay for having assumed a upward position, for in so doing we set aside the stable arch of most four footed animals and achieve in its place a mechanically unstable upright jointed coloumn with multiple curves.

So, to this basically mechanically unsound spine, any added insult

e.g. - injury
- excessive weight
- fatigue
or - muscle inadequacy

will serve to destroy the normal compensatory mechanism of spine and result in symptoms.

The most commonly described onset of lumbo-sacral strain is either in the act of bending over or in recovering from flexed position especially while lifting.

(c) Sacro-iliac-joint injury : This results only from rather severe trauma, the force ordinarily being either compressive or twisting. There is usually associated fracture of pelvic ring.

There are, however, some notable exceptions.

At three times of life, sacro-iliac ligaments undergo relaxation and render the joint vulnerable to injury from lesser degrees of trauma.

a) in adolescence during period of accelerated growth
b) during pregnancy
c) in senescence

All these times true sacro-iliac strain may occur.

The pain may be relieved by wearing a belt tightly around pelivc between anterior superior spines and greater trochanters. This will compress the pelvis and support sacro-iliac joints.

The compensable back injury is a special problem and differs from all other industrial injuries in cost and time lost.

Educating the low back-ache patient in desirable posture and body mechanics during activity will pay good dividends.

REHABILITATION :

The prime objective in all workmen's compensation systems should be to return the injured worker to work and to a useful life. We cannot stop at payment for disability. We must complete the circle and capitalise on ability rather than disability.

Ideally, rehabilitation should hit at the root cause of the disability

Prophylaxis :

No one disputes that an ounce of prevention is preferable to a pound of cure :

Measures suggested :

(1) Legislation for undue risks

e.g. poisonous substances act etc.

(2) Education on potential dangers and injuries thus caused.
(3) Application of ergonomic principles - reduses stress and strain which lead to raised accident rate through fatigue.
(4) Fire and accident procedures using proper equipment.
(5) Well trained first aid personnel - Re-examined regularly
(6) Pre-employment assessment of worker for :

- (a) Strength
- (b) Endurance
- (c) Co-ordination
- (d) Efficiency
- (e) Accident - prone personality.

The industrial physician should be provided with a similar book as "Estimates of worker trait requirements for 4,000 jobs" published by U.S. Department of Labour.

(7) Periodic health examinations to detect any changes in workers physic
(8) Register for all work accidents.
(9) Register for all accidents outside work
(10) Research into accidents.

Rehabilitation of the Disabled :

The problem of the disabled industrial worker. I think, will always be with us and it is for us to sharpen our skills.

On the credit side we have :

(1) Progress of medical sciences

(2) Changes which occurred in concept of rehabilitation resulting in a substitution of the predominantly biologic recovery with a more up-to-date concept of complex medical, professional and social rehabilitation.

(3) Scientific and techno-economic progress resulting in a reduction of physical effort and a corresponding increase in mental effort.

(4) State - Social Security, i.e. Welfare State

(5) Workmen's Compensation

Any, yet, there are so many other obstacles to overcome.

(a) In many instances industry is willing to employ the severely handicapped person but he is rejected by his fellow workers. This is a matter that will require education. The shop stewards are the people who should be invited to see a disabled person in training in a vocational guidance clinic.

(b) Delays in Board decisions

(c) Lack of rehabilitation centres and qualified personnel

(d) No organization to discover the disabled at a very early stage and include him in rehabilitation programme.

(e) Lack of a break through from administrative and economic limits of insurance to facilitate the physician who is no longer tied up with limits of funds and red tape forms granting the allowances.

(f) The lack of action for rehabilitation to be integrated in general health system with physicians at all levels participating in its achievement, looking after patient - superivising whole process from acute stage of illness upto his social integration.

CONCLUSION :

Rehabilitation comprises concrete steps based on residual
possibilities of disabled and organizational conditions available for
rehabilitation. The assessment of work capacity represents a ratio
between possibilities of disabled and the requirements of the job,
whereas rehabilitation is the action for improvement or optimati-
sation of his ratio under the given circumstances.

"The Secret of the care of the patient is in caring for the patient " (Francis Peabody)

Finally, let me show you a few slides and let the slides speak for themselves about rehabilitation.

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CARDIAC CASES IN INDUSTRY

By

Dr. P. A. Kale *

Synopsis

With the industrial revolution and the stress and strains of modern urban life, diseases of cardio-vascular system have come to the forefront. From the point of view of industry the cardiac cases can be divided into the following categories.

1. Congenital e.g. A.S.D., P.D.A., V.S.D., P.S. A.S., A.I.
2. Rheumatic e.c. M.S., M.I., A.S., A.I.
3. Ischaemic Ischaemic heart disease, syndromes like, angina pectoris coronary insufficiency, and myocardial infarction.
4. Cardiomyopathies & Myocarditis
5. Hypertension
6. Patients with permanent implanted pacemakers
7. Miscellaneous

Out of the above groups the hypertensive and the ischaemic heart cases form the largest percentage of cases, as they tend to occur after the person has already been employed in service.

It is now understood that this group of diseases have multifactional aetiology job surroundings and the persons interactions with these play a significant role in creation of new cases. As medical officers attached to industrial organisations are faced with four important aspects of these diseases:

1. Prevention of employment of unsuitable candidates
2. Detection of new cases
3. Rehabilitation of existing cases so that minimum man hours are lost.
4. Preventive measures to reduce the number of new cases

Importance of the following factors in achieving the above mentioned goals is stressed:

a) Prompt therapy and prevention of "Dropouts"

b) Regular exercise regimen~~t~~s on jobs.

c) Mass screening of persons " at risk" with regular periodical check up.

d) Reduction of occupational and travelling stresses.

e) Job reallotment and adjustment.

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SEMINAR ON LEAD

by

Dr. Salil Bhar*

INORGANIC LEAD

General Consideration: Lead is a heavy metal. It is the earliest metal used by man. There is a lead figure in British Museum made before 3000 BC, which makes the use of lead about 6000 years old. The chief source of lead is from the ore Galena (PbS) - there is no hazard of poisoning from mining of this ore. The other less common ore, Cerussite, $PbCO_3$ is relatively more soluble and is therefore, hazardous. Former sources were Spain and Britain, now USA, Mixico, Australia and Canada. Lead poisoning is a notifiable disease.

Route of Entry: Ingestion of dust. Inhalation of dust and fumes - dust is absorbed by 44% of the exposed population, whereas the fume is absorbed by 100%. Industrial cases of poisoning are usually from inhalation. Absorption is slow by any route.

Local effects: None

Systemic effects: Acute poisoning is virtually non-existent now-a-days. The main features of chronic poisoning are Colic, Palsy (wrist drop) and Anaemia. There is abdominal pain and tenderness - not localised but usually below the level of umbelicus - no rigidity, constipation, diarrhoea in the initial stage, loss of appetite, nausea, vomiting and weight loss. Wrist drop is the commonest form of palsy - muscles which are commonly used are affected first - weakening and paralysis of extensor muscels - in extreme cases food drop may occur. The cases encountered these days are of a mild nature and classical cases of wrist drop are rarely seen. There may be headache, muscular ache or cramps (Myalgia), and Arthralgia - Anaesthesia and Paresthesia - hoarseness of voice when the right recurrent laryngeal nerve is involved - Optic neuritis leading to blindness. Encephalopathy may occur particularly among children. Pallor is out of proportion to anaemia and is due to spasm of small vessls in the skin.

Pathology of anaemia - due to inhibition of haemoglobin synthesis by toxic action on porphyrin - forming mechanisms ; therefore many red cells formed are imperfect. Another factor for anaemia is accelerated removal of RBC from circulation. In the initial stage there may be polycythaemia. Stippling of red cells, coproporphyrinuria (III) (due to inhibition of haemoglobin synthesis enzyme).

Lead line may appear at the gingival margin (blue line) due to depositions of black lead sulphide. Lead is deposited in bone.

Investigation: Analysis of blood and urine for lead - in lead exposure the blood level is more than 70 micro gram/100 ml. and the urine level is more than 150 micro gram /1000 ml. Urine for coproporphyrin - 1000 micro

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gram /litre of urine may be asymptomatic, 3000 micro gram/litre is overt poisoning.

Examination of blood for stippled cells - 800 or more per million RBC = 10 per 50 oil immersion field (one such field contains usually 250 RBC).

Diagnosis : A falling haemoglobin level with or without a rising punctate count, when marked or progressive, indicate that absorption is passing into poisoning.

Preventive measures: Prevention is successful . Prevention of dust and fumes -hygiene in workshop - periodical medical examination.

Curative Treatment: Increase the excretion of lead by versenate (EDTA) and Pencillamine - Chelating agent. Dose of versenate : 500 mg. in 250 ml. of 5% glucose intravenous infusion every 12 hours for 5 days is one ' course'- repeat at one week's interval - Several courses may be necessary.

ORGANIC LEAD Tetra-Ethyl Lead (TEL) and Tetra-Methyl Lead (TML)

General consideration: These are volatile liquids - lipoid soluble. Used only since 1923, first in USA. TML is more volatile than TEL, therefore, more hazardous.

Route of Entry: Absorption of liquid through skin, inhalation of vapour.

Local effects: May penetrate the skin without producing appreciable local injury.

Systemic effects: CNS effects predominate - encephalopathy (Insomnia, Headache, Night mares, Nervouseness, fatigue, weakness, mental confusion, irritability, delirium and mania).

N.B. Colic, Palsy and stippling are absent .

Slow pulse and low blood pressure. Death may occur. Those who recover exhibit no harmful effects.

Pathology: These are made water soluble by liver (tri-ethyl, tri-methyl lead), then become toxic, effect the basal ganglia, cerebral and cerebellar cortex. Lesions are diffuse and focal. Micro glial proliferation.

Investigation: Analysis of blood and urine for lead.

Preventive Measures: Protective clothing - mask and air-line - under regulations.

Curative treatment: Removal from exposure, fluids -Pento - barbitone for insomnia, morphin is contra-indicated.

EDTA or BAL have no action.

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REFRESHER COURSE ON OCCUPATIONAL HEALTH

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EMPLOYEES' STATE INSURANCE SCHEME

By.

Dr. R.L. Narsing Rao*

S y n o p s i s

The Employees' State Insurance Scheme operates under the authority of the Employees' State Insurance Act, 1948 and Employees' State Insurance (General) Regulations, 1950. This is a premier social insurance scheme in our country. As the name implies, this is an insurance scheme where the beneficiaries have to pay regular contributions in order to be eligible to enjoy the benefits. The payments of such contributions is, however, compulsory under the Act for the categories of persons that have been specified. There is also no provision that any person may voluntarily join the Scheme. If such a person is not within the definition "employee" for the purpose of this Act.

AIMS AND OBJECTS

The aims and objects of the E.S.I. Scheme are to make certain provisions for the insured persons covered under the Scheme. The benefits conferred by the Scheme are as follows:

1) To provide medical care to the insured persons covered under the Scheme and their family members (Medical Benefit).

2) To provide cash benefit in lieu of loss of wages on account of illness or injury (Sickness Benefit and Extended Sickness Benefit - S.B. & E.S.b.).

3) To provide compensation in the form of periodical cash benefit for loss of wages caused by employment injury, while the insured person is under medical treatment (Temporary Disablement Benefit -T.D.B.)

4) To provide periodical payment of cash benefit for loss of earning capacity caused by employment injury (Permanent Disablement Benefit - P.D.B.).

5) To provide periodical payments to dependants of an insured person who died as a result of employment injury (Dependant's Benefit - D.B.)

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act to provide for certain benefits to employees in case of [illegible] employment injury & to make provision [illegible]

6) To provide periodical payment to an insured woman in case of confinement or miscarriage or sickness arising out of pregnancy, confinement or miscarriage (Maternity Benefit - M.B.).

7) To provide payment towards expenditure on the funeral of a deceased insured person (Funeral Benefit).

APPLICABILITY OF THE E.S.I. ACT

The E.S.I. Act extends to whole of India. So far, it is applicable to all factories where 20 or more persons are employed on any day of the preceding 12 months. For the purpose of this Act, a factory is one where a manufacturing process is being carried on with the aid of power. Seasonal factories, Mines, and Railway Running Sheds are explicitely excluded from the purview of this Act. Similarly, the Act is not applicable to defence personnel.

All persons employed for wages by a factory or establishment on any work connected with the manufacturing process or the administration of the factory or establishment or connected with the purchase of raw-materials or sale and distribution of the products are covered under this Act, provided their monthly wages do not exceed Rs. 500/-

While the E.S.I. Scheme is at present covering industrial establishments only, the Act provides that these provisions can be applied to any other industrial, commercial or agricultural establishments or any other class of employers.

ORGANISATION

Corporation: Under the E.S.I. Act, the E.S.I. Corporation is set up. The Chairman and Vice Chairman of the Corporation are nominated by the Central Government. The Chairman has all along been the Central Labour Minister. The members of the Corporation include persons nominated by the Central Government, State Government, representatives of the employers and employee, representatives of the medical profession and Members of Parliament elected by Lok Sabha and Rajya Sabha. Thus it may be seen that the Corporation is a body consisting of various interests that are connected with the operation of the E.S.I. Scheme.

Standing Committee: The Standing Committee is constituted from amongst the members of the Corporation in which also all interests are represented.

Medical Benefit Council: A Medical Benefit Council is constituted to advise the Corporation regarding the scale and nature of medical benefit provided at the Hospitals, Dispensaries, Clinics and other institutions and the nature and extent of medicine, staff and equipment which shall be maintained at such institutions and the extent to which these should be revised from time to time. The Medical Benefit Council also advises the Corporation about the medical certification and such other documents and statistical returns and other medical records that should be maintained.

The Medical Benefit Council recommends measures for the improvement of health and welfare of insured persons.

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Supplementary

The Director General of Health Services of Government of India is the Chairman of the Medical Benefit Council. Its members include nominees of Central Government, representatives of the State Governments who are generally Chief Medical Executives of the State or the Head of the E.S.I. Scheme of those States. Representatives of the employees, employers and medical profession are also included as members in the Medical Benefit Council. The Medical Benefit Council meets generally twice in a year and reviews medical side of the working of the E.S.I. Scheme and makes such recommendations as are necessary to maintain certain standards of medical care for the beneficiaries. These recommendations go before the Standing Committee and the Corporation which is the final authority for approving such recommendations.

Regional Boards : A Regional Board is set up for each Region which is normally a State. The Chairman and Vice Chairman of the Regional Board are nominated by the Corporation in consultation with the State Government concerned. The members of the Regional Boards consist of representatives of the State Government, Administrative Medical Officer in charge of the E.S.I.Scheme, representatives of employers and employees. The members of the Corporation and Medical Benefit Council residing in the State are also to attend Regional Board Meetings as ex-officio member. The Regional Board may also co-opt. a representative of the Medical Profession as a member. The Regional Board performs such administrative and executive functions as may be entrusted or delegated to it by the E.S.I. Corporation or the Standing Committee. The Regional Boards make recommendations for smooth and efficient functioning of the E.S.I.Scheme. They are advisory in nature.

Local Committees: A Local Committee is set up for such area as may be considered appropriate by the Regional Board. It consists of a Chairman nominated by the Chairman of the Regional Board. The members include representatives of the employers and employees. The Local Committee discusses the local problems in regard to the E.S.I. Scheme with a view to evolve efficient working and bring about co-ordination of all parties concerned. The Local Committee advises the Regional Board on matters which are connected with day to day work of the E.S.I. Scheme.

ADMINISTRATIVE SET UP

The Headquarters of the E.S.I. Corporation is located in New Delhi. The Director General is the Chief Executive. There are four other whole time Principal Officers namely (i) Insurance Commissioner (ii) Medical Commissioner (iii) Financial Adviser and Chief Accounts Officer and (iv) Actuary. These Principal Officers are appointed by the Central Government in consultation with Corporation. For the purpose of administration, the country is divided into various Regions and a Regional Office is set up at the Regional Headquarters which is generally the State Capital. In some Regions the Regional Headquarters is set up in a station where there is a large concentration of Industrial Workers. For example, in Uttar Pradesh the Regional Headquarters office is situated not in Lucknow which is the State Capital but in Kanpur which has a large concentration of industrial labour.

In each station in a Region, Local Offices and Sub-Local Offices are situated in industrial localities. These Local Offices receive the medical certificates brought to them by the insured persons and make cash benefit payments.

MEDICAL CARE

The E.S.I. Scheme, all over India is providing medical care to about 45 lakh industrial workers. It is estimated that we have in our country about 50 lakh eligible industrial workers. The remaining workers will be covered in due course. Taking into account all the insured persons and their family members covered under the E.S.I. Scheme, nearly two crores beneficiaries (actual figure as on 31.3.1974 -1,84,04,100) are receiving medical care under the Scheme spread over 18 States.

Under the Act, the medical benefit is provided by the State Government. But the Corporation, may, in consultation with the State Government concerned, undertake the responsibility for providing medical benefit directly.

Each State Government has a Chief Medical Executive who is responsible for operating the E.S.I. Scheme. The nomenclature of such Chief Medical Executive varies from State to State. Here in Maharashtra, he is known as Director, E.S.I. Scheme, in some States they are known as Administrative Medical Officer or A.M.O. and in other States they are designated as Joint Director, etc.

The Medical care provided under the E.S.I. Scheme has a three tier system.

Outdoor Medical Care: The general medical care at outdoor level is provided by Insurance Medical Officers at State Insurance dispensaries or by Insurance Medical Practitioners at their private clinics recognised by the Government for the purpose of E.S.I. Scheme. The former method is known as Service System and the latter is known as Panel System. The service Doctor (I.M.Os) are generally on par with the Assistant Surgeons of the State Medical Services. They are expected to treat the insured persons and their family members only. They are not allowed private practice.

The Panel Doctors are private medical practitioners who have their own dispensaries and para medical staff. They receive remuneration by way of capitation fees depending on the number of insured persons in their list. They have to give some ordinary medicines from their dispensaries. Most of the drugs needed in day to day practice are supplied to the insured persons and their family members by Approved Chemists or Governmental Medical Stores on prescription given by the panel doctor.

In some cases the dispensary of the employer is used to provide general medical care to the insured persons.

Mobile dispensaries on wheels are also used where necessary to take the medical care to remote areas where small pockets of insured persons and their families live.

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SPECIALIST SERVICES

Diagnostic Centres are set up in implemented areas where there are sufficiently large concentration of beneficiaries. Various Specialists attend these Diagnostic Centres to examine the insured persons and their family members. The Consultant's advise the insurance doctors regarding further management of the patients. Patients are not directly entertained at these Diagnostic Centres. They will have to be referred by their I.M.Ps/I.M.Os. After referring the case to the Consultants, the I.M.P/ I.M.O. should further manage the case as advised by the Consultant.

HOSPITAL CARE

For indoor treatment of insured persons, special hospitals are constructed at various stations. Except in Delhi, in all State, the hospitals are managed by the State Government. Only the insured persons and where such medical care is extended to the family members, their family members are authorised to receive treatment in these hospitals. Being exclusive hospitals, no outsiders are allowed any treatment. The general standard of these hospitals is higher than the public hospitals.

The Corporation has decided to provide 4 beds for 1000 employees at present. After this target is achieved the bed strength may be increased. Till the Corporation is able to complete the construction of hospitals to achieve the full bed strength reserved beds are taken in Government or private hospitals on payment of specified fees.

At present the E.S.I.Corporation has 56 hospitals with a total bed strength of about 9000 as on 31.3.1974. 1000 more beds are going to be added up to them.

Another 9 hospitals are coming up to add another 2000 beds.

The patients are given free all the necessary and essential medicines for the treatment of the disease and no one is asked to bring any medicine from outside.

Ambulances are provided under the E.S.I. Scheme for transportation of the patients.

Artificial limbs are supplied free to insured persons who have lost their limbs in any type of injury. Provision is also made for repair/ replacement of artificial limbs supplied to insured persons.

Hearing aids, spectacles, dentures and hand driven tricycles and wheel chairs are supplied to those who need them, if such a need arose on account of employment injury.

Antenatal care, confinement, post natal care and Family Planning advice and appliances are provided free to all insured women and family members of insured persons.

Immunisation programme has been recently introduced under the E.S.I. Scheme for the benefit of insured persons and their family members.

When E.S.I. Scheme is implemented in a station, the insured person is entitled to all the services mentioned above. But so far as family members are concerned, all the services may not be available from the beginning. For this purpose the medical care is devided into three categories namely, "Restricted", "Expanded" and "Full" medical care. Where "Restricted Medical Care" is provided the family members also get the same standard of medical treatment as insured person.

The family members who are eligible for medical care are the minor dependant children and dependant parents.

FINANCES OF THE CORPORATION

The main sources of the funds are the contributions from the employees and employers. Contributions are compulsory and collected by the Corporation from the employers in implemented areas. The employer has to deduct the employees contribution from his wages at a rate specified in the E.S.I. Act. The employer's special contribution is double of the insured person's contribution. The State Governments bear 1/8 th of the cost of medical care subject to a certain ceiling.

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Central Labour Institute
Eastern Express Highway
Sion, Bombay 400 022.

PERSONAL PROTECTIVE EQUIPMENT

LEGAL REQUIREMENTS:

Under the various provisions of the Factories Act and rules thereunder suitable personal protective equipment is required to be provided by the management.

REQUIREMENTS OF PERSONAL PROTECTIVE EQUIPMENT:

i) Adequate protection against the hazards to which the worker will be exposed,
ii) Maximum comfort and minimum weight compatible with protective efficiency.
iii) No restriction of essential movements.
iv) Durability and susceptibility of maintenance on the premises where it is used.
v) Construction in accordance with the accepted standards for performance and material.

NEED FOR PERSONAL PROTECTIVE EQUIPMENT:

In industry it may be possible to substitute a danger as substance with a safer substance, to isolate the process, to have automatic and mechanical handling of the substance or to have controlled ventilation of the process or to plan and arrange operation that personal protective devices are not necessary; but sometimes it may not be possible to introduce such measures or there might be a breakdown in the plant or in the control measure. Under such circumstances it will become necessary to use personal protective equipment. It must be borne in mind that personal protective equipment do not eliminate a hazard. These devices are designed to interpose an effective barrier between a person and harmful objects, substances or radiations.

TYPES OF PROTECTIVE EQUIPMENT:

Personal protective equipment may be divided into two broad groups:

i) Respiratory Protective Equipment
ii) Non-respiratory Protective Equipment.

Selection of equipment to protect different parts of the body will depend upon the hazardous conditions like injurious mechanical contact, injuries chemical contact, etc.

-RESPIRATORY PROTECTIVE EQUIPMENT:

Atmospheric contaminants range from the relatively harmless substances to toxic dusts, fumes, smokes, mists, vapours and gases. Processes which present hazard of exposure to harmful substances should, if possible, be enclosed or ventilated to eliminate or minimize the hazard. If enclosure, ventilation or other engineering means of control are not possible or become very costly to apply to the degree required to ensure absolute safety, respiratory equipment should be provided to the workers exposed to possible danger. Even though engineering means of control are applied satisfactorily, a supply of appropriate protective equipment should be readily available for use, as there will be plant breakdowns and repairs may have to be carried out in contaminated environments. Respiratory protective equipment should be considered a last resort, or as stand by protection and never substitute for effective engineering control.

i) CLASSIFICATION OF HAZARDS:

Type of hazards to which a worker is exposed is the basis of selection of the right type of respiratory protective equipments. The hazards may be classified as under:

a) Oxygen Deficiency:

Atmosphere in confined spaces such as vats, tanks, tanks holds of the ships, etc. may contain air with oxygen content much lower than the normal (21% by volume). This may be due to dilution or displacement of the air by other gases or vapours or because of loss of oxygen due to decay of organic matter, chemical reaction and natural oxidation over a long period of time. A person breathing air with oxygen content of 16% or less may exhibit symptoms ranging from increased rate of breathing, acceleration of pulse rate to unconsciousness and death. Such oxygen deficiency condition can easily be detected as the flame of a safety lamp will be extinguished in such atmosphere. The respiratory protective equipment, in such conditions, should either supply normal air or oxygen to the wearer.

b) Gaseous Contaminants:

These may be toxic or inert gases. The toxic gases may produce harmful effect even if they are present in relatively low concentrations. The inert gases produce undesirable effects primarily by displacement of oxygen. The term 'gases' includes vapours of volatile substances.

1) Gaseous Contaminants Immediately Dangerous to Life: These contaminants are gases present in concentrations that would endanger life of a person breathing them even for a short period of time. In other words, a gas is 'immediately dangerous to life' if it is present in certain concentration. Where it is not possible to determine the extent of concentration or the kind of gas is not known, all gases should be considered as "immediately dangerous to life'.

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2) <u>Gaseous Contaminants not Immediately Dangerous to Life:</u> These contaminants are gases present in concentrations that could be breathed by a person for a short time without endangering his life but which may cause possible injury after a prolonged single exposure or repeated short exposures. But even after the concentrations of the contaminant is known, no exact formula can be applied to determine if the contaminant is immediately dangerous to life or not.

c) Particulate Contaminants (Dusts, Fumes, Smokes, Mists, Fogs):

Majority of particulate contaminants are not immediately dangerous to life. They may be solid, liquid, or a combination of solid and liquid and may be classified into three broad groups.

1. <u>Toxic particulate contaminants:</u> These when inhaled may pass from the lungs into the blood stream and are then carried to the various parts of the body. The effect may be chemical irritation, systematic poisoning or allergic reactions. Common contaminants in this group are antimony, arsenic, cadmium, chromic acid and chromates, lead and manganese.

2. <u>Fibrosis - producing dusts:</u> These dusts do not pass into the blood stream but remain in the lungs and may cause pulmonary impairment. The common examples under this group are asbestos, coal, bauxite and free silica.

3. Nuisance Dusts: These may dissolve and pass directly into the blood stream or may remain in the lungs neither producing local or systematic effects.

d) <u>Combination of Gaseous and particulate Contaminants:</u>

The gaseous and particulate contaminants may be entirely of different substances like carbon monoxide and oxides of nitrogen produced by blasting and the dust from the blasted material or the may be the same substances in liquid and vapour from like volatile liquids.

ii) <u>Types of Respiratory Protective Equipment:</u>

Respiratory protective eqhipment may be classified as indicated in the appendix.

A P P E N D I X

CLASSIFICATION OF RESPIRATORY PROTECTIVE EQUIPMENT

Breathing Apparatus

- Supplied Air
  - Air Line
    - Air line respirator
    - Suction Hose Mask
    - Pressure Hose Mask
  - Self-contained
    - Demand type
      - Compressed air
      - Compressed oxygen
    - Recirculating
      - Compressed oxygen
      - Oxygen Regenerating type
- Air purifying
  - Chemical filters
    - Cannister Gas mask
    - Chemical Cartrige Type
    - Self rescue type
  - Mechanical filters
    - Nuisance Dusts
    - Micro Filters.
  - Combination of Chemical & Mechanical Filters

1. Air-line Respirator: Air-line respirator essentially consists of a face-piece (half or full mask or a loose fitting helmet or hood) to which air is supplied through a small diameter hose. It may be continuous flow typr or demand type.
In a continuous flow type, air is supplied continuously to the face-piece helmet or hood. Exhaled air or the excess air entering the face-piece escapes to the surrounding atmosphere. Air supplied should be at least 110 ltrs. of air per minute to enter the face-piece at least 170 ltrs. per minute to enter the helmet or hood.

In a demand type respirator, air is supplied to a face-piece when the wearer inhales and the rate is governed by his volume rate of breathing. Air from an air compressor or cyclinder of compressed air is supplied to the face-piece through a deman valve which is actuated by the slight negative pressure created when the wearer. inhales. On exhalation the demand valve closes and exhaled breath escapes to the surrounding atmosphere through exhalation valve. Helmets or hoods are not used with demand type respirator.

Air-line respirators provide protection so long as the air supply is maintained but the wearer's travel is restricted by the length of the air supply hose. Care should be taken to ensure that the air supply is respirable and is not contaminated and is free from objectionable odours, oil or water and rust particles from the supply line.

2. Suction Hose Mask: It consists of a full face-piece connected to a large diameter flexible hose. The wearer draws in air by his own breathing effort. The hose is attached to the wearer's body by a suitable safety harness with safety line and the air inlet end of the hose is provided with a filter to arrest particulate matter. Air can be drawn in by inspiratory effort of the wearer upto 30 ft. length of the hose.

3. Pressure hose Mask: This hose mask is similar to suction hose mask except that the air is forced through a large diameter hose by a hand or motor - operated blower. The blower is to be operated continuously while the mask is in use.

4. Self contained Compressed air or Oxygen Breathing Apparatus: This is a device by means of which the user obtains respirable air or oxygen from compressed air or oxygen cylinder which is an integral part of the apparatus. In a demand type self-contained breathing apparatus, air or oxygen is admitted to the face piece through a two stage pressure reducing mechanism, only when the wearer inhales and the quantity of air or oxygen admitted is governed by his breathing. The wearer's exhaled breath escapes to the surrounding atmosphere.

In compressed oxygen cylinder recirculating type breathing apparatus, high-pressure oxygen from the cylinder passes through a pressure reducing and regulating valve into a breathing bag. The wearer inhales this oxygen through a one-way breathing valve and his exhaled breath passes into a cannister containing chemicals to absorb exhaled carbon dioxide and moisture and then through a

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cooler into the same breathing bag. Oxygen enters the breathing bag from the supply cylinder only when the volume of gas in the bag has decreased sufficiently to allow the supply valve to open.

From respiratory point of view, self-contained breathing apparatus has no limitation as to the concentration of the gas or deficiency of oxygen in the surrounding atmosphere but other factors may limit the time that the wearer can remain in a contaminated atmosphere. Many gases are very irritating to the skin and many can be absorbed in dangerous amounts through the unbroken skin.

5. Oxygen - Regenerating Recirculating type Self-contained Breathing apparatus:

In this apparatus moisture content from the wearer's breath reacts with granular chemical in a cannister to liberate oxygen. Also the exhaled carbon dioxide is absorbed by the chemicals in the cannister. This oxygen enters the breathing bag from which the wearer inhales through a corrugated breathing tube connecting the bag to the face-piece.

b) Air Purifying Respirators:

1. Cannister Gas Mask: This consists of a a cannister, containing appropriate chemical, a full face-piece and body harness to hold the cannister in place on the body of the wearer. Air is drawn through the cannister by the wearer and during its passage through the chemical in the cannister contaminant present in the incoming air is absorbed reacted with a neutraliset. The cannister areddesigned for specific gases and it is very important that the appropriate type is used.

The cannister gas mask can only be used in atmosphere not deficient in oxygen and not containing more than 2% by volume of most toxic gases. Also, the life of the cannister will depend upon the type of cannister, the concentration of gas and the activity of the wearer.

2. Chemical Cartridge Respirator: This consists of, usually, a half-mask attached to one or two cartridges. Like cannisters, the cartridges are filled with appropriate chemicals to absorb gases or vapours drawn through them. This respirator is a non-emergency gas respirator and it should not be used in an atmosphere deficient in oxygen. Like cannister gas mask, chemical cartridge respirator provides respiratory protection for a period that depends on the type of cartridge used, the concentration of the gas or vapour, and the wearer's activity. It is recommended for low concentration gases and vapours(max. of 0.1% of organic vapour).

3. Self-rescue Type Respirators: This is designed to provide the greatest possible respiratory protection consistent with the practicability of carrying the device at all times so that it is always available for use during escape. It consists of a small filter element, a mouth piece, a nose clip and means of carrying conveniently on the body. The filter elements are similar to chemical cartridge. The extent of protection afforded is between that provided by cannister gas mask and that provided by a chemical cartridge respirator.

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4. Mechanical Filter Respirators: These remove particulate matter from the inspired air which passes through a filter. These filters may be of the single use or re-usable type. If these respirators are used in heavy concentrations of particulate matter, the filling will be clogged with dust articles too quickly and they may have to be replaced every now and then.
Micro filters are special filters designed to arrest ultra microscopic size of dust particles and these are used where extremely fine dusts are encountered.

5. Combination of Chemical and Mechanical Filter Respirators:
They remove toxic gases and vapours and particulate matter from inspired air. Common example of their use is in spray painting ~~xx~~ work.

iii) SELECTION OF RESPIRATOR:

The following factors should be considered:

a) Nature of the hazard,
b) Severity of the hazard,
c) Type of contaminant,
d) Concentration of the contaminant,
e) Period for which Respiratory Protection must be provided,
f) Location of the contaminated area with respect to a source of respirable air,
g) Expected activity of the wearer, and
h) Operating characteristic and limitations of the available respirator.

iv) CARE OF RESPIRATORS:

Instructions in the use of Respirators, among other things, should include the following aspects:

a) Why it is to be used,
b) How it is to be used,
c) Checking that it is in good operating condition.
d) Fitting of respirator on the wearer, and
e) Proper use and maintenance of the respirator.

NON-RESPIRATORY PROTECTIVE EQUIPMENT:

Personal protective equipment equipment for various parts of the body can be divided into five broad groups:

i) HEAD PROTECTIVE :

Head protectors may be hard hats and caps made of aluminium, PVC, fibre glass, laminated plastic or vulcanised fibre. They may be fitted with brackets for fixing welding masks, protective face screen, or a lamp. The hats and caps are provided with replaceable harness which provides sufficient clearance between the top of the head and shell.

Soft caps and hoods are also used for protection against heat, spark and other dangerous materials and are made of appropriate materials. Some times hoods are made with rigid frame which is held away from the head.

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ii) EYE & FACE PROTECTION:

Numerous eye injuries are caused by dusts, flying particles, splashes and harmful radiations. It is difficult to cover precisely the various processes in which the worker may be required to wear goggles. The hazards encountered may be:

Relatively large flying objects	Chipping, fettling, Rivetting, sledging, caulking, etc.
Dust and small flying objects	Scaling, grinding, stone dressing, wood-working.
Splashing of metals	Babbiting, pouring of lead joints, casting of metals, galvanising and dipping in molten metals.
Splashing of liquids, gases and fumes	Handling of acids and other chemicals
Reflected light, glare and radiant energy	Foundry work, glass furnaces, gas welding and cutting, arc welding.

Eye protectors may be safety spectacles, mono-goggles, impact goggles, welding goggles, foundry goggles, chemical goggles, gas tight goggles, face shields, welding helmets etc.

iii) HAND & ARM PROTECTION:

Protection of hands and arm becomes necessary when workers have to handle materials having sharp and sharp edges or when hot and molten metals, chemicals and corrosive substances have to be handled. The protection devices may be guantlet gloves, wrist gloves, mittens, hand pads and thumb and finger guards and sleeves. It is important no only that the various parts of arm and hand are adequately covered, but that they should be covered by a material suitable for withstanding the specific hazard involved.

Sustained heat	Asbestos, asbestos reinforced with leather, Aluminished fabric
Sparks	Asbestos, fire resistant duck, glass fibre.
Hot metal splash	Leather, fire resistant duck glass fibre.
Dust	Fabric, coted fabric, plastic, natural rubber, synth, rubber.
Chips & Abrasion	Fabric, leather, coated fabric.

Cuts and Blows	Leather reinforced with steel, metal mesh.
Electricity	Rubber
Moisture	Coated fabric, natural rubber, Plastic, glass fibre.
Acids, Alkalies and other chemicals	Natural rubber, neoprene, p.v.c.
X-rays	Rubber, leather, plastic with lead lining.

iv) FOOT & LEG PROTECTION:

Adequate foot protection may have to be provided to the workers employeed in certain jobs. Risk of injury may be in handling of heavy materials, caustic and corrosive liquids, wet conditions, molten metals, etc. Common foot and leg protective devices are safety shoes and boots, leggings, foot-guards and leg guards. Shoes and boots may be provided with steel toe-box and inner steel sole, and they may be ankle, calf or thigh or hip high. They may be made of leather, asbestos, neoprene, natural rubber, synthetic rubber.

Leg protectors may be in the form of leggings which may be knee high and they may be spats which should be lower shin, ankle and instep. They may be held in position by straps or spring clips or snap fasteners.

v) BODY PROTECTION:

Sometimes it becomes necessary to provide special protective equipment for the body in the form of aprons, coveralls, jackets and compelete head to toe protective suits. Nature of potential hazards, degree of the hazard involved and nature of activities of the person concerned are important considerations in the selection of safety clothing. Although complete coverage of the body and legs is not needed in many cases and unnecessary safety clothing may hamper the efficiency of the worker, no compromise should be made with strict safety requirements . If a worker needs complete coverage, he should have it.

Besides the above five groups of protective equipment there are devices for protection against noise in the form of ear plugs and ear muffs and safety belts for working in pits or at heights or in confined spaces.

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